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ONCE UPON A TIME.

THE HOW AND WHY LIBRARY

LITTLE QUESTIONS THAT LEAD
TO GREAT DISCOVERIES

BY

MRS. ELEANOR ATKINSON

Author of *Greyfriar's Bobby*, *The Boyhood of Lincoln*, Etc.

SCHOOL STUDIES MADE AS FASCINATING
AS FICTION FOR CHILDREN AND
READERS OF ALL AGES

*Includes an Explanation of the Beginning and Brotherhood of Life as Every
Mother Wishes her Child to Know It; A Trip Around the World; Picture
Visits to the Great Industries and Intimate Insights into the Ways
of Men, Birds, Flowers, Insects, Wind and Weather*

FILLED WITH BEAUTIFUL AND INSTRUCTIVE
ILLUSTRATIONS—MANY IN COLORS



The objects of the Congress shall be to bring into closer relations the home and the school; . . . to surround the children of the world with that wise, loving care in the impressionable years of life that will develop good citizens.—*From the Constitution of the National Congress of Mothers.*

To bring parent and school into closer relations is so important that we cannot overestimate it.—*Charles McMurry, Professor of Education, Northern Illinois Normal University and Contributing Editor to The New Student's Reference Work.*

CHICAGO
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THE "WHY" OF THE HOW AND WHY LIBRARY



IT IS well known how eager all normal children are to go to school.

By "school" we mean not so much the Common School, as the Commoner School we call "Life."

A child instinctively asks questions. Curiosity is the appetite of the mind. His questions show that his mind is all ready for the answers. If they are given wholesome encouragement and direction, he will grow to find the greatest pleasure as well as profit in learning about the great and good things of the world he has inherited rather than the silly and the bad.

The answers can be made and are here made to lead straight into invention, art, science, engineering, good morals and good citizenship, preparation for a successful life—the development of a clean, strong body and a clean, strong mind.

To bring home and school into such practical co-operation in the development of the child—that is the greatest idea in the modern educational system; that is the purpose of the "How and Why Library." Its articles have a field all their own. They do not take the place of the delightful story books for children—of which there are many that are good in spite of the fact that there are so many that are either worthless or bad. Neither do they take the place of the text book. They prepare for the text book before the child starts to school; they supplement it after he begins.

Did you ever stop to think what a big thing a little key is? The "Hows" and "Whys" between these book covers are the keys to this wonderful world of ours. Without such keys the child cannot enter—cannot understand. This is the tragedy of the old school methods.

Modern education is entering a field of glorious possibilities for our children, but we must do our share. The school can help the home, but the home must help itself. The mother-teacher, the father-teacher, the big-sister and big-brother teachers must come back again.

After all, they're our children—our little brothers and sisters—aren't they?

Open the door and walk in—children and all. Because it is such a remarkable work for children, it is none the less a work of infinite charm for readers of all ages.

THE PUBLISHERS.

FOREWORD

REFERENCES: In the articles throughout this volume will be found frequent references to related titles for further reading or study. For example, the article on the "Good Luck Family" has this notation: "See Legume, Clover, Shamrock." The articles thus referred to will either be found in the present volume, as indicated in the Table of Contents, or in "The New Student's Reference Work," a descriptive announcement of which appears in the back of this book. These references have been made owing to the wide distribution of the "Student's," the ease with which reliable information can be secured in its pages and the fact that it has a place in the libraries of most of those who own "The How and Why Library."

ACKNOWLEDGMENTS: Grateful acknowledgments are made for the right to use valuable illustrations and for suggestions in the preparation of "The How and Why Library" to publishers, educators, public officials and others. Among these we wish to specially mention The Scientific American of New York, the Technical World Magazine of Chicago, the Woman's Magazine of New York, the Cleveland Leader, the Cleveland Plain Dealer, Charles K. Reed, publisher of the Bird Guide; J. J. West, Chief Scout Executive, and E. H. Merritt, Secretary of the Editorial Board, Boy Scouts of America; L. O. Howard, Chief of the United States Department of Entomology, Washington, D. C.; A. F. Sherman, Acting Commissioner of Immigration at Ellis Island; the Chicago Art Institute; Professor John M. Coulter, head of the Department of Botany, University of Chicago; and C. H. Speers, General Passenger Agent of the Colorado Midland Railway.

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Every child has an instinctive interest in the great industries and how the wheels "go round." Familiarity with these processes is one of the most practical phases of Geography teaching in our schools, and the co-operation of the home, if supplied with appropriate material, is easy and desirable. Nine typical industries of special interest to children are graphically presented in this department.

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HOW AND WHY OF ETIQUETTE

Dr. Eliot says the subject matter of this section is one of the most important parts of education. "Manners" and knowledge of certain social forms are no less valuable in "getting on" in one's life work. Lack of such information and training frequently explains why some succeed while others of equal or greater natural ability, fail. Self control, grace of bearing, ease of expression, the habit of drawing out the best in others—these things the world rightly regards as the real tests of education. Yet proper and sensible guidance is difficult to find.

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STORIES IN GEOGRAPHY

CHILDREN OF OUR OWN AND OTHER LANDS

EDITORS' NOTE TO MOTHER AND TEACHER.—The study of descriptive and political Geography is introduced into the very first year of school, through travel stories. The first interest that little children show in other people and lands, is in the way other children live, particularly those of primitive peoples like the Indians and Esquimos, and people whose ways of living are radically different from their own. Geography teaching now takes advantage of this curiosity, on the part of the children, to introduce them to the general study. In this way they get a knowledge of the physical appearance, manners and customs, climate, products and transportation of other peoples and countries, in addition to some history and physiography. The supplementary reading with the geographical aspect, supplied to the lower grades, is very wide and comprehensive. To cover all that is supplied, requires the purchase of a great number of little supplementary readers, each at a cost of from thirty to fifty cents.

This geographical department covers the most essential and attractive features of any one dozen supplementary readers, and has, besides, a unity of plan that none of the readers possess. The plan is to present primitive America, when it was inhabited only by the red child, then to bring the other children in, over the sea, in the chronological order of the colonization and settlement of the United States. The order followed here is the Indian, the English Puritan, the French, the Dutch and the Negro. The Esquimo peoples were visited very early by the New England whalers, and the Spanish colonists by trading vessels that went to Havana.

When once the sea-board was peopled, came the period of the hunter in Kentucky. There the experience of Daniel Boone is taken as typical. This paved the way for the pioneer of the Lincoln period. During this time there were large migrations of German and Irish peoples. The discovery of gold carries the settlement of the United States to the Pacific coast. The subsequent development of California, as it is today, follows.

Once having reached the Pacific coast, curiosity is led to take the world-round journey, to visit the children of the yellow and brown races, and the children of the Desert and the Alps. The world journey is logically completed by the return to the New York City of today, and a description of Castle Garden, where more than a million people of foreign lands are still entering America every year. This last feature is not to be found in any child's reader on the market.

The object, in these nineteen sketches, has been to present typical pictures of such facts as children are curious about, that will furnish a

complete image that they are likely to retain, and upon which they can build further knowledge. There is also the object of creating sympathy, and consequent breadth of mind. The travelled person is always a man of wider culture and sympathy, than is the same man if he should stay at home and never come in contact with any other mode of living or thought than that in which he was born. This creating of sympathy with other people is of extreme importance in a country like ours, which is constantly being recruited by foreign peoples. We are far too apt to under-rate these newcomers, and to think that we are offering them all and receiving nothing in return. As a matter of fact there are no people who come to us but have some gift or contribution that they can make to the general welfare and pleasure.



PAINTED BY E. IRVING COUSE, A. N. A.

"THE HISTORIAN"

The Indian artist is painting in sign language, on buckskin, the story of a battle with American Soldiers. When exhibited at the National Academy this picture was considered one of the most important paintings of the year. See if you can find the sign for the Indians, the United States Cavalry and the officer in command. The dots he is making now are "bullets." See the arrows?

CHILDREN OF OUR OWN AND OTHER LANDS

I. THE RED CHILD OF THE FOREST

You are proud of being an American boy, aren't you? Perhaps you will be surprised to learn that there is another boy who has a better right to the name than you have. He was here four hundred years ago, when Columbus sailed over the wide ocean and found our country.

This American boy was tall and straight and slender. His eyes were as black as ink, his hair as black as a crow's wing. He could run like a deer, swim like a fish and climb like a squirrel. He was as solemn as a little owl. When he grew to a man he wore a head-dress of eagle feathers. You may find his picture on the copper penny in your pocket. The boy was very nearly the color of the penny, too. Now you know what he was. He was an American Indian. There are still a good many Indians in our country. They live in houses, on big farms. They dress like white boys, speak English and go to school. But their faces are the same as those Columbus saw.

It was a hard, wild life the Indian boy lived. Still, he had a good deal of fun. It was like camping out all the time. There were four or five million Indians here, but the country was so big that there was room for everybody to move about a good deal. There were no cities or farms; no railway trains or wagons. The Indians had to travel on foot. They followed narrow paths, or trails, through the forests and over the plains. On the rivers and lakes they made long journeys, in boats so light that they could carry them on their shoulders from one stream to another. These boats they called canoes. They were made of birch bark stretched over frames of wood. A great many Indians travelled together, for company and for safety. Each band was called a tribe and each had a chief. When a tribe found a good place to camp, some poles were stuck in the ground in a circle. The top ends of these poles were tied together. Then the skins of wild animals, or mats woven of rushes were fastened over the poles. They called this tent a wigwam. Some Indians built dome-shaped

wigwams, like circus tents. Others built long houses of bark, big enough to shelter the tribe.

Our little Indian boy was born in a circus tent wigwam, in a village of other wigwams, in the forest. His mother put a long shirt of soft yellow deer skin on him, and taught him his first lesson before he was a day old. She taught him that he must not cry. When he cried she put her hand over his mouth. She did this because cruel enemies and wild animals might hear him. When he grew up he could bear any pain without complaining.

The Indian baby could not even kick. His mother bound him to a flat piece of birch bark, to make his back and legs straight. She hung "the baby and cradle and all" from her shoulders. She wrapped a big skin around herself and the baby, if it was cold weather, leaving his face uncovered so he could see. Then they went "by-by." Any baby would like that. When the tribe stopped to rest, the baby and his cradle were hung from the limb of a tree, and the wind rocked him to sleep.

Someone was always saying "don't" to the Indian boy and girl. "Don't make a noise when you walk. You must not even rustle a leaf, or snap a twig." That might scare away the deer father was trying to kill, and then the family must go hungry. Sometimes, when out hunting, a boy had to lie for an hour, as quiet as pussy at a mouse hole. The Indian boy had to learn to strike fire from two pieces of flint; to make a bow and a stone arrow head; to make a canoe and snow shoes. He shot arrows at a mark every day; he speared fish, and threw stone hatchets. These hatchets were called tomahawks. He must be able to tell what kind of weather was coming, and learn to read the picture writing on the sign posts set up in the forests. He must learn the ways and places and calls of animals and birds, and be able to follow the tracks of men and wild beasts. He had to learn how to fight, too, or he and his family would be killed. The Indian boy was grown to a man before he had learned all his lessons.

One sign that he had grown up was that he was given a name. It was really a nickname, given for something he had done. This name he had to bear all his life, so he was very careful not to do anything foolish or cowardly. If he did something brave, and got such a name as Eagle Heart, he was so proud he couldn't sleep the first night. The Indian man was proud and brave and cunning. Sometimes he was cruel. No man could use him for a slave.

THE RED CHILD OF THE FOREST

PAST AND PRESENT

THE Indian medicine man thought he could cure disease by frightening away the evil spirits supposed to cause it, so he wore horns and other things to make him look savage. What is this medicine man wearing that used to belong to Brother Bear? Indians, when they live in wigwams, believe in medicine men, as Eagle Heart did, but most Indian children now go to school and know better. The two



From the Statue by Dallin.

THE MEDICINE MAN

center pictures show the boys and girls studying art and manual training at the Indian school at Carlisle, Pa. In the summer the boys and girls at Carlisle are allowed to work on neighboring farms where they can earn a little money and learn how farming is carried on. Our government has established a number of Indian schools and keeps them up at a cost of several million dollars a year.



"She hung the baby and cradle and all from her shoulders."



Some tribes wrap up their babies in buckskin bags.

These are wigwams like that in which Eagle Heart was born. They are made of the skins of wild animals.

If Eagle Heart's sister was a merry little maid she might be called Laughing Water. Isn't that a pretty name? Laughing Water had lessons to learn too. She had to help her mother take the skins from the wild animals the hunters brought home, and cut up and cook the meat. She had to help scrape the hair from deer skins with sharp clam shells, and rub and pull the skin until it was as soft as a kid glove. A needle she made of a fish bone; the thread of the leg tendons of the deer. Her thread was like our violin strings. It was very strong. Then she sewed the skins into shirts and leggings and moccasins and robes. She embroidered moccasins and belts with little shells, after boring holes through them; and she colored porcupine quills and pushed them in patterns through the soft yellow skin. She colored long eagle feathers and made a warrior head-dress for her father. She made herself necklaces of shells.

In the summer, the Indian women and girls dug holes in the fields, with pointed sticks or clam shells, and planted corn and beans, pumpkins and tobacco. Laughing Water had to gather the ripe corn, shell it, boil the grains in clay pots, dry them and pound them to meal in wooden bowls. She sifted the meal through a sieve she made of fine, tough grass. She wove baskets of reeds and grasses. If she had time she wove colored figures and lines in her pretty baskets. She made clay cooking pots and water jars, and she painted figures on them. One of the nicest things she did was to make candy. She made it by boiling the sweet sap of the maple tree. For her father, Laughing Water dried the broad tobacco leaves. He put these in a pipe with a stone bowl and a hollow reed stem, and smoked them.

In the evening the whole tribe sat around a big fire under the maple trees. The tired hunters smoked and talked of the hunt, or of battles. Old men and women told stories of long ago. The Indians had no books, but their old stories were not lost. Grandfathers and grandmothers told these hero tales to the children, and the children remembered the stories and told them to their grandchildren. Some day you must read "*Hiawatha*" and learn more about how the first American boy lived.

Eagle Heart and Laughing Water thought their home would always be as it was then. They did not know that little children with pale faces were coming to live among them.

See Plate "*Natives of North America*," Vol. I, page 60. Also see INDIANS, page 921; AZTEC, page 150; PUEBLOS, page 1559. Also in Index under INDIAN see numerous references.

II. THE LITTLE PALE FACES WHO CAME OVER THE SEA

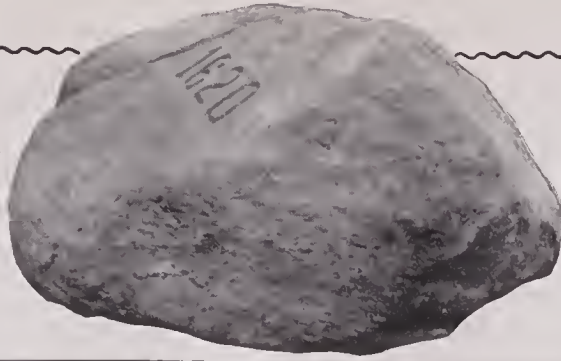
Six year old Faithful was knitting a stocking. Her home was a pretty stone cottage with a thick roof of straw. It was in a village, in England. Roses grew around the open door. Through the door she could see the square, gray tower of a stone church. Ivy climbed the tower. The bell in the tower rang sweet chimes. The church had pointed windows of many-colored glass. The fences between the cottages were thick green hedges. A mill stood beside a dancing river. The mill-wheel churned the water to foam. On a hill top stood a castle in miles of green park, with a stone wall around it. Lords and ladies lived there. Sometimes they drove to the church in a gay coach, or they went away to the King's court in London. They wore silks and laces and plumes and jewels. Little Faithful's English home was as pretty as a fairy story. But her father often talked of going away to the New World of America, that Columbus had found, to live. They were all safe and comfortable in England, but they were not happy. They dressed and lived more soberly than their neighbors. They liked to go to a plain meeting-house, instead of to the King's stone church. For this they were punished. Unkind people mocked them, and called them Puritans. But they were proud of that name because they tried to live pure lives.

Faithful wore a long, plain gown of dark wool. A square of white lawn was folded around her neck. On her head was a stiff white linen cap almost like a sunbonnet. Her little face was rosy and dimpled; her loving eyes as blue as violets. Her yellow hair just *would* curl, and that was a trouble. A little Puritan girl had to keep her hair smooth. She wore a white apron, with a pocket to hold her thimble and thread. The Puritans thought it wicked for even a little girl to be idle. Her brother Myles wore a wide-brimmed pointed hat, knee breeches and a tightly buttoned coat. He wore a wide, square-cornered white lincn collar. Both of these children had big brass or silver buckles on their stout, low shoes.

One day their father said they must get ready to go to America. Other Puritan families were going with them in a sailing vessel. They had to take ever so many things with them, for they could not

SCENES IN THE PILGRIM STORY

PROTECTED BY
A GRANITE CAN-
OPY AND BY BARS
TO KEEP RELIC
HUNTERS FROM
CHIPPING IT
AWAY, THE ROCK
ON WHICH THE



PILGRIMS LANDED
STILL LIES AT
THE WATER'S
EDGE AT PLYM-
OUTH WITH THE
DATE OF THE
LANDING CARVED
UPON IT.



The Mayflower has just arrived and its passengers are landing on the "bleak New England shores."



The Pilgrims sadly watching the Mayflower as it sails back toward the comfortable homes in old England which they have given up for "freedom to worship God."



Even when they went to church the Pilgrims were obliged to go armed to protect themselves against attacks by the Indians.

buy even a paper of pins in America. They packed big chests with clothing and blankets and feather beds and table linen. Cooking pots and pewter dishes and candle sticks were put into barrels. The mother did not forget the spinning wheel and loom for weaving. The father thought of tools and seeds and guns and knives and fish nets. He put in a box of books, too. He did not take money. To trade with the Indians for furs, he took red blankets and calico and beads.

*One hundred Pilgrims stood on the deck of the Mayflower and said goodby to the green shores of England. Every one of them could do something useful. There were carpenters and shoemakers and blacksmiths and farmers. There was a soldier to lead them if they had to fight the Indians. A minister went with them, and a wise man to govern them. Puritan mothers could do nearly everything to make people comfortable. The little girls could knit and sew and mind the baby. The smallest boy could whittle wooden shoe pegs.

It was a long journey, in cold winter weather, over the sea. The Atlantic ocean is three thousand miles wide. Today we cross this ocean in steam-ships, in five days. But the Pilgrims came over three hundred years ago, in a little sailing vessel. The voyage took six weeks. Big waves beat the sides of the ship and rolled it almost over. The snow fell thick and ice covered the deck. Fogs shut them in, so they could not see where they were going. Icebergs as big as hills floated in the water, and they saw whales. By and by they saw sea gulls. They were near land.

The land was not green and pleasant like England. All they saw was black rocks, bare forests and great fields of snow. The Pilgrims got into little boats and rowed over foamy breakers to this land. They knelt on the rocks and prayed and sang hymns. And they named the bleak coast New England, after their old home.

How the trees fell in that forest! Twenty men with sharp axes chopped all day long. Soon the Pilgrims had warm log houses, with chimneys of clay and sticks. Doors of axe-hewn boards were hung on wooden hinges. Thick oiled paper covered the small holes left for windows, but there was plenty of light from the big fire of logs. The straightest logs were split and laid for floors. The carpenters made tables and stools and bedsteads. The blacksmith

* This first company who landed at Plymouth Rock, were called Pilgrims: those who came later and settled at Boston were known as Puritans.

swung long iron bars in the chimney to hang cooking pots over the fire. Everything was carried from the ship into the houses. Then the Mayflower sailed away home. The little pale faces were alone in the wide, wide, New World of America, with the red children of the forest.

They had a great deal to show each other. The Indians brought corn and told the white people how to make mush and hominy. They brought maple sugar to make syrup. They had very small grains of corn that burst into flowers when they got hot. Wasn't pop-corn a surprise? Faithful and her brother got fur hoods and mittens. They coasted on hillsides and ran on snow-shoes. They had baked Indian beans and pumpkin pudding to eat, and wild turkey with cranberries. In the summer they found wild grapes, plums and crabapples, strawberries, blackberries and blueberries. In the fall there were nuts of many kinds. They gathered wax bayberries to make sweet smelling candles. The carpenters made boats to fish for big cod. The children dug clams from the sand on the beach.

How cosy it was, in the log home in the evening! Half a tree could be put into the fireplace. The children ate their supper of hominy and syrup and deer meat from Indian bowls of wood. But they had white linen cloths and napkins. They brought their manners and their prayers and their school books to America. A woman taught them to read and write and spell and "cipher," in one of the cabins. To "cipher" is to do arithmetic sums by hard rules. They learned their letters from a horn book. The horn book was more like a slate than a book. Their only reader was the Bible. Faithful read the Bible through three times, before she was twelve years old. Besides she helped her mother. In America she had to learn to sweep a room clean with an Indian birch broom, and to brush the hearth with a turkey wing. She spun flax and wove cloth. She made soap by boiling lye water, dripped through wood ashes, and animal fat together. This made strong, brown soft soap.

Her brother went into the woods with his father to cut down trees. The forest land had to be cleared for fields, to grow corn and wheat and flax. Around every cabin was a little garden to grow peas and cabbages and flowers. Oh, how the children watched the first green sprouts come up. And how they clapped their hands when they saw the first English daisy or pink rose. The flowers made America seem more like a real home. In the fields and woods

were violets and buttereups, as in England. One tiny, sweet-smelling flower that pushed its pink, waxy elusters and glossy leaves right through the snow, in the pine woods, was strange to them. This they ealled the Mayflower, after their dear little sailing ship. Once in many months a sailing vessel came and brought them things from England. When it sailed away it took the furs of bears and beavers and foxes to sell in London.

Sometimes the Puritans and the Indians had dreadful battles. The red man wanted the forests for hunting, and the white man wanted the land for farms and towns. Every little settlement of white people had one big eabin that was both a meeting house and a fort. The men earrried their guns and knives to ehureh. They carried them when they went to the fields to plow. Sometimes they built high walls of pointed stakes around the village. After many years the Indians went deeper into the woods and left the eountry near the sea to the white people. The Puritans learned to love their home in New England. No one ever thought of going baek to Old England. They had many little towns around a sea-port city ealled Boston.

Other English people who were different from the Puritans came to Ameriea, but Faithful and Myles never saw the little drab-gowned, soft-spoken, Quaker ehildren who lived near the town of Philadelphia. Neither did they see the English ehildren who lived in big houses by the wide rivers of Virginia. Ameriea was so big that the towns were hundreds of miles apart. Little Duteh ehildren came to Ameriea to live, too, and Freneh ehildren and Spanish children, but they all lived so far from each other that they could not pay visits. We ean go to see them today. Do you know how?

In the fairy story, when the Little Lane Prinec, who was shut up in a tower, wanted to go to the land of Far Away or Long Ago he sat down on a magie earpet. Whisk! He sailed through the air as easily as a bird.

III. LITTLE WOODEN TWO SHOES

Let us follow the Mayflower as it sails back home. All the white children who came to America had to cross the Atlantic ocean. We won't stop when the ship comes to England. We will go farther over the sea.

Why, what is this? Trees growing on the edge of the ocean, and no land at all! Yes, here it is. The land lies behind the trees and lower than the water. Wouldn't you think the sea would roll in and drown the pretty red and yellow tulips in their beds? It would if the people had not built high banks of earth. These banks were called dykes. There were wide roads, bordered by trees, on top of the dykes. Crossing the low country were other wide, high dykes. Long troughs were scooped out of the tops of them, and sea water let in to make canals. Isn't it funny to see ships sailing on these canals, away above the church steeples? The towns and farms lay in deep, green bowls of land.

On the banks of the canals were windmills. The wind whirled the long, ladder-like arms. This turned big wheels in the wooden towers. Windmills ground flour and sawed wood and pumped water. The Dutch people built them in Holland where they lived. They made the wind do their hardest work. Weren't the Dutch clever people?

The people worked hard, too. Very early in the morning the men opened the shutters of the shop windows. The women scrubbed the door steps and swept the streets. Then they scrubbed the rosy faces of the children, put clean clothes on them and sent them to school. Their children, their houses, their neat brick towns, and even their farms, were so clean and bright that all Holland looked as if it was washed and ironed every day.

Clump, clump, clatter! Here comes blue-eyed Gretel in her wooden shoes, with little tow-headed brother Hans after her. Wooden shoes were good for many things. Hans sailed his on the canal, like boats. Gretel used hers for dolly cradles. At Christmas Santa Claus filled their shoes with sugar plums. Every Saturday Dutch children scrubbed their shoes with soap and water, until they were as white as little mother's kitchen table.



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"LITTLE WOODEN TWO SHOES" ABOUT TO EMBARK TO AMERICA.

Hans wore wide knickerbockers, a tight jacket and a little round cap. Gretel wore six bright wool petticoats, all at once. Her close, gold-braided cap had big rosettes over the ears. They skated on the canals in winter. They went to a big city called Am-ster-dam, in an ice-boat, with a sail. The wind sent the boat flying over the ice.

Hans and Gretel came to America with other Dutch children. They lived on a long, narrow island in the mouth of the Hudson River. The island poked its blunt nose into the ocean, so ships could come up to it. It was higher than the water, so the Dutch did not have to build dykes. But they built a wall of stakes across the island to keep the Indians out. They built a windmill too. If there had not been lots of water the Dutch children would have been as lonesome in America as ducks in a meadow. The Dutch men were merchants. They bought furs of the Indians and sent them to Holland to be sold. When the ships came for furs they brought loads of bricks to build houses. A street of neat brick houses was built like the letter U around the blunt nose of the island. The fronts faced a green park; the gardens all ran down to the water. The Dutch called this town New Am-ster-dam. After many years English people came to live with the Dutch, and they named the town New York. Today nearly four million people live in New York. It is one of the biggest cities in the world.

The great-grand-children of Hans and Gretel had two homes. One was a brown stone house in the city. The other was far up on the high, rocky bank of the Hudson River. It had a porch with white pillars, and forests and meadows were around it. They had a gay coach and fast horses to drive into the city, and they had a sail boat on the river. They spoke English instead of Dutch, and they wore leather shoes with buckles. They were Americans. They never dreamed of such a thing as going back to Holland. See NEW YORK, page 1334.

IV: SHIP LOADS OF POLITENESS

Very near Holland lived other children who came to America. They were French. Their names were Louis and Jeanne. French people did not like to live alone, on separate farms. When the day's work in the fields was done, they liked to visit each other. So they lived in farm villages. The stone cottages and barns, the cow sheds and chicken yards, and the kitchen gardens of twenty families, were all mixed up together in the friendliest way. Tall, slim poplar trees grew in the door yards. On a rock-cliff, above the village, was a gray stone castle with many pointed towers. In French it was called a chateau (chat-ó). A noble lord lived there. He owned the farms and the village. Everybody had to pay rent to him. Farmers who went to America could own their land and houses.

When Louis and Jeanne said goodby to their playmates their little faces were pale, their black eyes filled with tears. They kissed people, first on one cheek and then on the other. And they said: "Adieu, cher ami!" That was French for "goodby, dear friend, we will never see you again." French children were polite. Politeness means both kind feelings and pretty manners.

Louis and Jeanne came to America in one of a fleet of ships. On the big sailing vessel that led the fleet, was a company of the king's soldiers, in gay uniforms. They had a band of music. A white flag with golden lilies on it floated from the mast. The soldiers were going to build a fort. On the other ships were miners to dig for gold, workmen and farmers. There were noble lords and ladies too, and black-robed priests, and nuns to teach the children.

The French fleet sailed far south; south of Virginia, south of the rice and cotton fields. Then the ships turned west until they came to the wide mouth of the Miss'is-sip'pi River. Soon they passed a French town on the river bank. Its name was New Orleans. The fleet did not stop there. It sailed up the river hundreds of miles. The fort was built of lime stone from the high bluff that ran along the wide, brown flood of the Miss'is-sip'pi.

Cannon were set up on the walls. Soldiers watched by the cannon. They did not watch for Indians. The Indians and the

French were good friends. They were friendly because the French were so polite. Louis called Eagle Heart his "wild brother." Jeanne kissed Laughing Water on both cheeks, and gave her a red ribbon for her hair. The soldiers in the fort watched the Spanish people who lived on the western bank of the Miss'is-sip'pi. The French and the Spanish people both claimed the big river, and they quarrelled about it. They did not need to. There was plenty of room for both.

In the shelter of the fort the farm village was built. The houses were not made of stone, as in France, but of squared logs, set on end and the cracks filled with plaster. The roofs sloped out over porches. Above the porches dormer windows jutted from the sloping roof. Roses and honeysuckles climbed the porches. There were cherry trees and peas in the garden, and tall slim poplar trees in the dooryards. In the evening there was gay talk and dancing. On St. John's eve, in June, a bonfire was built. They could see other bonfires, of other French villages, along the river. This was a part of New France in America.

The French built forts and towns on the St. Lawrence River, far to the north of the Puritans, in Canada. They called two of these towns Que-bec and Mon-tre-al. They built Detroit and other places on the Great Lakes. All along the waterways, far in the deep heart of America, you can today find places the French people named after their kings and saints. But the French soldiers went back to France long ago, and the forts crumbled. The French farmers and traders stayed in America.

Louis and Jeanne learned to speak English, but they did not forget French. Today, thousands of people in Canada speak both English and French. Our warm, southern city of New Orleans is almost as French as many cities in France. If you should ever go to New Orleans you might come to know some pale, black-eyed, polite French children. When you go away they will kiss you on both cheeks, and say goodbye. But sometimes they seem to forget that they are Americans. Then they say: "Adieu, cher ami."

V. LITTLE FRIENDS IN FURS

Before they came to America to live, the English and Dutch people were great sailors and traders. If they heard of anything they wanted, in far-away lands, they sailed away in stout ships to get it. As soon as they had a few seaport towns in America, they built sailing vessels. They needed some things that they could not buy in England and Holland.

They needed oil for lamps. They had no gas. They had no electric lights that you turn on with little black buttons. They did not even have kerosene oil. They had only candles of tallow and wax, and not enough of those. In one place there was plenty of oil. Strong, brave men could go and get it without paying money. It was in the ocean. Would you ever think of looking for oil in the water?

The oil ships sailed north into cold, dark, stormy seas. Even in summer icebergs were all around them. The sun shone, day and night. It went 'round and 'round the sky in wide circles. Polar bears were on the ice. Swimming, yellow seal barked like dogs. Walrus showed their ivory tusks. Millions of eider ducks nested on the rocky shores. Whales spouted water when they came up to breathe. The oil ships had come for the whales. Under its rubbery skin the whale was wrapped in a thick blanket of fat. When it was melted this whale blubber made good oil for lamps.

The whaling ships had to hurry to get back home before winter. In the far north it was night all the time, in the winter. The sun did not shine at all. The ocean froze over. Sometimes the sailors staid too long and their ships froze fast, in the ice.

When this happened the sailors had to go on the land to live. The land was all ice and snow too, but there were people and warm houses. A village looked very queer. It was only a lot of dome-shaped mounds of snow. Rough dogs ran from low holes in the snow huts. They made such a noise that little furry heads popped out of the holes, too. If it had not been for their fat, human faces, the sailors might have thought these children were polar bear cubs. They were Es-qui-mos, a kind of small, brown Indians. They were good-natured and friendly. It was so cold that they had to wear the skins of animals. They had soft, warm stockings of eider duck

LIFE AMONG THE ESQUIMOS

IT SEEMS odd to think of Esquimos jumping the rope, but this is one of their forms of amusement. As you see, it is not the children alone that enjoy it. Below is shown the inside of an Esquimo hut. Isn't that a queer doorway? Perhaps this man is coming home to a meal. What do you think about it? In summer these huts melt and are replaced by others of earth or hides, like those in the next illustration.



In building these huts a circle is first traced, then slabs of packed snow are laid around this circle and a house built in the shape of half a globe—something like the sugar bowl hut of the children that live in the "Zoo."



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Summer camp of a very interesting tribe of Esquimos living in North Greenland.

skin, with the down inside. Their polar bear skin jumpers had hoods. Their high boots were of reindeer skin. Es-qui-mo children were as warm and brown and greasy as buttered toast.

The children showed the white visitors the way into the house. They stooped at the low hole and slid down a toboggan tunnel. They climbed into the middle of the house through a cellar door in the floor. This was a clever way to let people in and keep the wind out, wasn't it? The house was built in a pit, of drift wood. Wrecked ships and uprooted trees floated to them from far-away lands. The frame work was covered with sod and moss. Snow fell thick on the house and froze solid.

An Es-qui-mo house had no windows, not even a hole for the smoke to go out. A bench around the wall made a table, a bed, and seats for just as many men, women, babies and dogs as could crowd into the hut. They could hardly see each other for the smoke. The hut was warmed and lighted by earthen lamps that hung from the ceiling. These had moss wicks and burned walrus fat. Over the lamps meat was cooked in earthen pots.

Ice-bound sailors often had to live with the Es-qui-mos all winter. They went hunting with the men. The stout dogs pulled the hunters on sleds made of animal bones. They killed seal and walrus and bears, with long spears called harpoons. It was not as dark as you would think. The stars and moon shone on a white, frozen world. Sometimes there were lights brighter than our sunsets; more wonderful than Fourth of July fire-works. They played all around the midnight sky in colored flames. They formed columns and crowns, curtains and banners. Ask mama to turn back to Volume I, page 140, and read to you about the *Aurora Borealis*.

When the sun came back and the ice broke up, the whalers went home with a ship load of oil in barrels. Their friends thought they were lost in the icy seas. When they were old men they sat in the bright light of whale-oil lamps and told stories of their adventures. The white children never grew tired of hearing about Agh-a-ni-to and Ny-ack, who lived in a snow house and dressed like polar bears. See ESKIMO, page 626.

VI. CHILDREN FROM SPAIN

Other ships sailed away for sugar. They found sugar right here in the New World. When Columbus came across the sea, before any other white man, he came in a Spanish ship. He found warm islands and the mainland, far south of where the English and Dutch people afterwards came to live. Spanish people followed him. They were glad to find that sugar cane would grow in many parts of tropical America. Sugar was worth a great deal of money. Do you know, no one, not even kings, had enough sugar to eat until shiploads of it were sent to the Old World from America?

Puritan and Dutch and Quaker lads often went as cabin boys, on the ships that sailed to the Spanish colonies for sugar. The farther south the ships sailed, the warmer it grew. The sun was high and bright; the sea and sky very blue. A steady wind blew all day long and filled the white sails. They passed dozens of green islands. On the islands were palm trees. One of the most beautiful things in the world is a palm tree, with a crown of green plumes, on the hill top of an island, against a blue sky. What would you think, then, of an island that was seven hundred miles long, and more than a hundred miles wide, lying in a sea as blue as indigo, and all its hill tops plumed with twenty-five kinds of palm trees?

"O-o-o-o-h!" is what the cabin boys on the sailing vessels said, when they saw Cuba. It was such a big island! It was so lovely, so green, so rich in fruits and other food plants. It had such wide harbors for ships, and it lay among smaller islands, right where all the ships would have to pass to go to lands beyond. No wonder the Spanish people called Cuba "The Pearl." No wonder they built their finest city in America, on the widest harbor of this jewel of an island. This city they named Havana. It was one hundred years old when the English and Dutch came to America to live.

To get to Havana a trading ship had to run the flag of its country up the mast. Then it sailed through a narrow passage into the harbor. The city was guarded by castle forts. It had a high wall around it. Over the wall, church towers and palm trees and roofs of red tile could be seen. It looked like some old Spanish city sleeping in the sun. Perhaps a Spanish merchant, in white

cotton clothes and a palm-leaf hat, invited the captain and the cabin boy to his home for breakfast.

Inside the walls of the city were low, one and two storied houses. They were colored pink and blue and lemon yellow. They were roofed with fluted red tiles from Spain. The streets were narrow. There was a public square, a palace for the royal governor, and a cath-e-dral where ladies went to church. They wore black gowns, and shawls of black lace on their heads. In the house they wore white or gaily colored silk.

Juan (Wan) and Dolores (Dol'o-rees) ate their breakfast in the patio. The patio was the inside garden of a Spanish house. The house was built all around it. The patio was paved with marble. It was open to the blue sky. There was a fountain in it. Palms and pink o-le-an'ders, and orange trees with white blossoms and golden fruit, grew in tubs. It was cool and quiet.

The children were cool and quiet, too. They wore white cotton clothes, and sandals without stockings. They had soft black eyes and pale, cream-tinted faces. They were very polite, but rather lazy. Negro slaves waited on them. They ate oranges and bananas and pineapples. They drank chocolate and cocoanut milk. They gave their visitors salted olives and sugary raisins from Spain. If a visitor admired anything they said: "Take it, señor; it is yours." But unless it was some trifle he was not expected to take it.

These Spanish children were rich—oh, very rich. Their father had been to Mexico, or Central America, or South America. He went with Span-ish soldiers who had guns and swords and cannon. They found Indians who were different from those in the north. These Indians had built cities and palaces and temples. Some of them had built stone roads over mountains and deserts. They worked the mines, and had treasures of gold and silver. But they had no guns or cannon. The Spanish soldiers killed the strong men, and made slaves of the children. They made these slaves go into the mines for more gold and silver. Most of them died. Ship loads of wealth were sent back to Spain. Rich Spaniards went back, too. Only some poor soldiers, and black slaves and dying Indians stayed behind, to build towns and make farms. After the gold and silver was all taken away, the Spanish king still kept soldiers and officers in Havana and other towns. He made all these poor people pay taxes. It was four hundred years before all these Spanish countries in America won their freedom from Spain. One of the

big Spanish islands belongs to us, today. It is called Porto Rico. It is near Cuba, and very much like it, but smaller.

Cuba, "The Pearl" of all the islands, is free today, and our country watches over it so no big nation can steal it. You can go to Havana in a fast steamship. The castle-like forts are still there, guarding the harbor. The harbor is full of ships that come for sugar, tobacco and coffee berries, oranges, bananas and pine-apples and many other good things to eat. The president of Cuba lives now in the palace of the old royal governors. In the cath-e-dral you must take off your hats. It is a church, and besides Columbus is buried there. His bones were brought from Spain to the New World he discovered. Don't you think that was right? White people and negroes, and even a few Indians live in Cuba. They are all free, now, and they all speak Spanish. The low houses under the palm trees are roofed with red tiles; the walls are painted pink and blue and lemon yellow. The little children eat their breakfast in the patio. If you admire anything that belongs to them they will bow politely and say:

"Take it, señor; it is yours." If the gift should be a little cage full of fire-flies I would take it. It would make a pretty lantern to flash and glow in the orange tree in the patio. See CUBA, page 485, and HAVANA, page 847.

VII. THE LITTLE BLACK CHILDREN WHO LIVED IN A "ZOO"

It was noon but the little boys and girls were all asleep, in the huts under the palm trees. No, they were not *still* asleep. They had got up with the sun, but when the sun was high and hot they went to bed again. Their fathers and mothers were asleep too.

The huts were as round as big sugar bowls. You might think there was sugar inside of them from the swarms of ants and flies. The walls of the huts were made of bark, the cone-shaped roofs of long palm leaves. The trees and the river seemed to be asleep, and the comical monkeys in the trees, and the ugly crocodiles in the river. The leaves were wilted by the heat. Among the drooping leaves hung cocoanuts as big as baby brother's head, and bunches of fat, yellow bananas. By and by a shower of rain fell and cooled the air. The rain was like the kiss of the prince in "Sleeping Beauty." The crocodiles yawned, the monkeys chattered, little black heads popped from the doors of the huts. Then the whole village of people tumbled out of doors.

Such funny little boys and girls! You would have laughed to see them, and they would have laughed to see you. They were as happy as kittens and laughed at everything. They were black all over. That was easily seen for they had no clothes on at all. They had big, black eyes with very white rims. Their teeth were as white as ivory, and their hair curled tight to their heads in little knots. They laughed and cried and talked and screamed. They were as noisy as the monkeys in the trees. They were negro children. Their home was in the hot jungle of a far away country called Africa.

Every child had his breakfast in his hands. Some had bread made from the flour of the manioc root. They all had baked yams, a kind of sweet potato; and ground nuts, something like our peanuts. The babies sucked sugar cane. Maybe some of them had eggs, for there were little speckled Guinea chickens in the village. They drank from long-handled gourds, and from cocoanut shells. They were as fat as little butter balls.

These children could not swim in the river, for the crocodiles would bite them in two. They did not wash their faces. When they had put bracclets of iron and copper and ivory on their arms

and ankies; strings of bright feathers, colored bone beads and crocodile teeth on their necks, they were dressed. The boys had aprons or capes of spotted leopard skin that they wore when they went with the men to hunt elephants and other animals. They carried spears and vine ropes and big baskets. Some went in palm-tree boats to hunt other animals that lived in the river.

The women and girls planted yams and ground nuts in the fields. Slaves helped them. These slaves were black people like themselves, who had been captured in battle. The women made cooking pots of clay. They wove baskets and water jugs of reeds. Water jugs were woven very close, and the cracks filled with gum from trees, so they could not leak. Negroes did not have to work as hard as Indians, but they were always in danger of being carried away for slaves.

In the evening the hunters came home with elephant tusks and baskets of meat. Perhaps it was the flesh of the hippo-potamus, a big water pig. Perhaps—why, it might have been almost any kind of wild beast! Lions and tigers and leopards; elephants and rhi-noc-er-oses and gi-raffes; striped ze-bras and swift an-te-lopes, and go-ril-las, or man monkeys with long hairy arms, and many more queer animals live in Africa. You can see them in cages in a men-ag-er-ie, or in the park zoo, today. Most of them are as terrible as their names. They did not often come into the villages, for they were afraid of the spears and traps.

One noon-time, when everyone was sound asleep, a band of painted black warriors stole into this village and made all the people prisoners. Men and women and little children had to march along the river bank. The river grew wider, and marshy plains lay along the banks. After the plains was white sand, and miles of blue water with foam caps on the waves. The black children screamed with fright. They had never seen the ocean before. They were frightened again when a ship with white wings sailed into the river mouth. Worst of all they were driven into the darkest part of the ship, under the deck, by strange looking white men.

Two hundred years ago black people were sold as slaves in many countries. Few people thought this was wrong. Ship loads of negroes were brought to America. The good Puritans bought some of them, and the gentle Quakers. Most of the slaves were sold in parts of America where it was warmer than in New England.

IN THE BLACK CHILD'S HOME



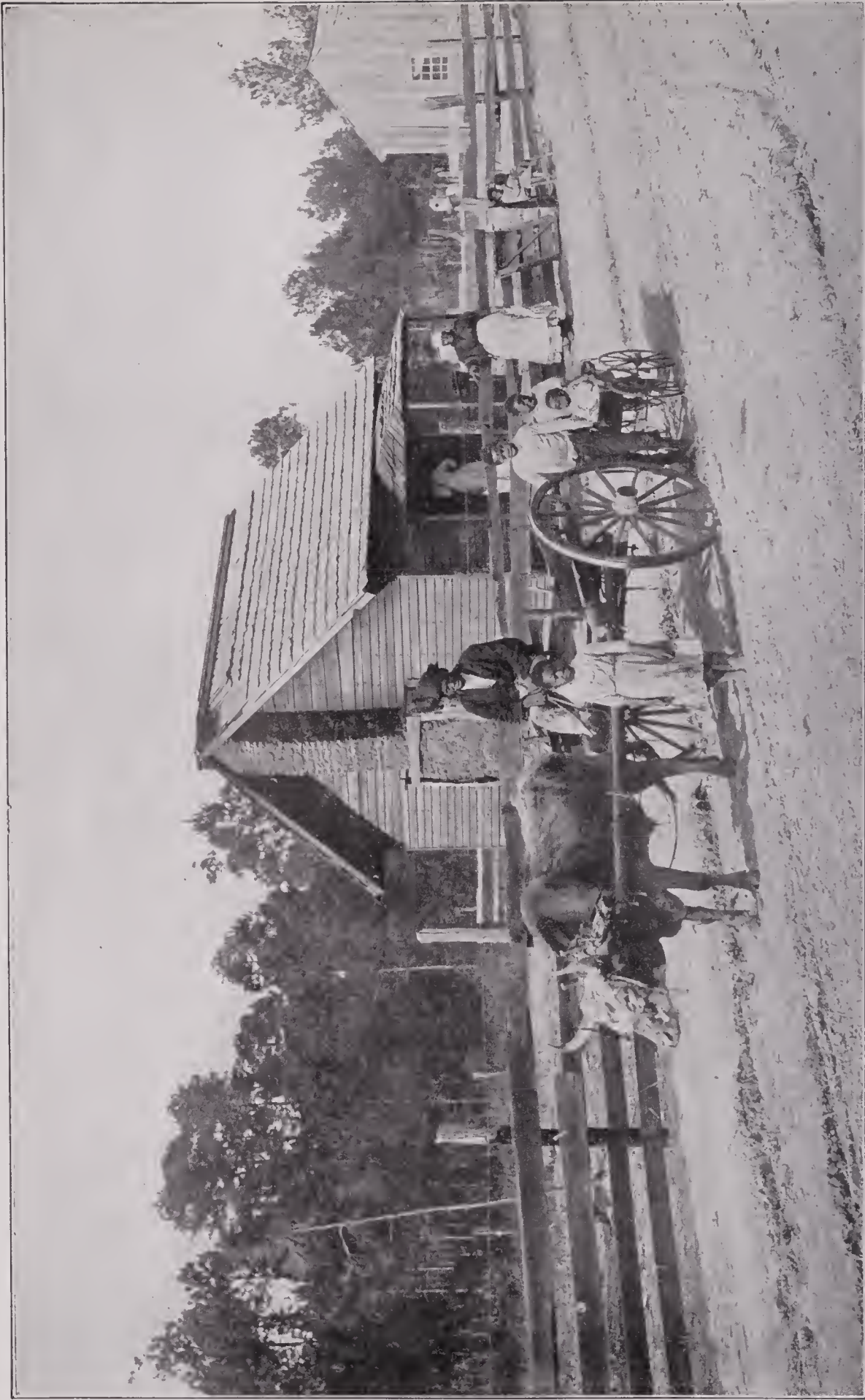
Among all nations before mills are introduced, people must crush their own grain before they can bake it. In Africa they do this in mortars with big pestles.



On the left is a group of African natives on the Zambesi river, and beside them a band of Zulus, a people who are particularly troublesome when on the warpath.



You can guess from its name what animal is fond of the fruit of this giant monkey-bread tree. Compare it with the slender palm trees on the right and the huts there shown with the one back of the Zulu warriors.



A HAPPY NEGRO FAMILY IN ALABAMA.

Virginia was warm and green like England. Many English people who came to live there were richer than the Puritans. They had large farms called plantations, and lived in big houses with white porches. Velvet lawns shaded by trees sloped to rippling rivers. Tobacco could be grown there, and that was worth much money in London. Slaves were bought to work in the tobacco fields.

The negro slaves lived near the master's house, in a village of log cabins. Calico dresses were given to the women and trousers to the men. The children had loose, short-sleeved shirts of tow linen. They slept in beds now, and sat on chairs and ate from tables. Everything was strange to them, even the way the white people talked. A boy or girl who learned quickly was taken from the field into the house. A little black boy might be called Sambo, a little girl Topsy. The negroes were not proud and brave like the Indians, nor were they cruel. They were never envious and hateful. The black "mammy" loved the little white baby she nursed. Sambo liked to catch the horses and ride with Master Roger. And Topsy liked to iron pretty dresses, to make frosted cake, and to powder and puff Mistress Evelyn's hair, lace her rosy-flowered gown and buckle her satin slippers when she went to a ball.

Many slaves were sold farther south than Virginia. They toiled in rice and cotton fields, cut sugar cane and picked coffee berries. You remember how the black children were always laughing and talking in the village of palm huts? Even after they became slaves in America they were happy, if they were warm and well-fed, and had kind masters who did not make them work too hard. On the plantations, in the evening, they talked and danced, and played on drums and bone rattles and banjos. Negroes have as sweet voices for singing as any people in the world. Sometimes the master's family, sitting in the moonlight, stopped talking to listen to the negroes singing. Perhaps your mother or big sister knows some of these negro songs. Today we love to sing "My Old Kentucky Home," "Old Black Joe," "'Way Down Upon the Suwanee River," and many other pretty negro songs.

The negroes were slaves in America for two hundred years. Then they were all set free. None of them want to go back to Africa, to the old wild life. They want to stay here and live like white people and send their children to school. They are Americans, too. They call themselves Afro-Americans.

VIII. BABES IN THE WOODS

Once they got started, people kept coming and coming and coming to America as if they never would stop! In our own part of North America, that is now the United States, three million people were living a hundred and fifty years after the Puritans came. There were many thousands of negro slaves. Most of the white people were English. We owned all the land from the Atlantic ocean to the Mississippi River. This land was fifteen hundred miles long and a thousand miles wide. But all those three million people lived on a narrow strip of land along the sea coast. They began to feel crowded.

Why didn't they move back from the sea, and spread over the land? They couldn't. There was a wall. It was a wide, high, double wall of mountain ranges. The wall was nearly straight, but the seacoast bent in and out. Here the land ran away out into the water. There the water took a big bite out of the land. So in some places the seacoast land was more than a hundred miles wide. In others it was much narrower. The Indians were pushed and pushed back by the white people. At last they went over the mountain wall. They went by a trail that the white men could not find for a long time.

White men lived far up on the mountain slopes. The land there was rough, rocky hills. It was not good for growing corn and wheat. Men had to hunt like Indians to get enough to eat. They were strong and brave and hardy. They could do everything the Indians did. Much of the time they lived in the woods. While in the mountains back of the Virginia plantations, a party of white hunters found the Indian trail over the wall. It was through a high, narrow valley. The Cum-ber-land River started there, in mountain springs. It cut a deep pass through which men could ride on horseback. The pass was called Cum-ber-land Gap.

These daring hunters went through the Gap and down the Western slope. They built no fire. They kept their food pouches filled, their moccasins tied to their guns. They rolled in blankets at night, and slept on their guns. They thought the Indians might see them. On the least alarm they slipped into the deep woods. One morning they saw a park-like country at their feet. There

were miles and miles of green meadows, with bright rivers and giant trees. The park was full of deer and other game.

The white men made up their minds to stay in this fair wilderness. They built some cabins inside a log fort. More men, and a few women and children were hurried over the Gap, and into the rude fort. A white baby was born there. There was even a wedding in the fort. Then began a life of daring and danger of many years. The earliest Puritans had not lived so hard a life as these hunters in Kentucky and Tennessee. They were hundreds of miles from the French towns on the Mississippi. The mountain wall was behind them. Ships could not come to them. They could neither buy nor sell anything.

Some years they dared not go outside the forts to grow corn. The men slipped out to hunt. Sometimes they did not come back. The Indians followed them and killed them. Sometimes painted red warriors danced around a fort. Very little boys had to learn to shoot, to protect their mothers and sisters. But more white people came. A hundred came for every one killed. They found another trail over the mountains to the Ohio River. They came down this river in keel boats. The Indians shot at them from the banks. Fleets of canoes followed the keel boats. Then soldiers came and fought battles with the Indians, so white people could live in that country. At last, after thirty-five years, there were little log towns and lonely cabins, scattered all through Kentucky and Tennessee.

Daniel Boone was one of the hunters who built the first forts. Find the story about him. Then we will tell you the story of a boy who was born when Daniel Boone was more than seventy years old. He was born in one of the lonely cabins in the woods of Kentucky. That was one hundred years ago. We will learn how he lived, what he did, and what kind of a man he became.

IX. PIONEER DAYS AND WAYS

It was a cold morning in mid-winter, one hundred years ago. Around the little log cabin the snow lay deep among the stumps of trees in the clearing. A zig-zag fence of rails was around the field and the cabin. Blue smoke rose from the chimney of sticks and clay. You could easily have gone into the cabin because there was no door. A buffalo robe was hung before the doorway for a curtain. Wild beasts from the forest—bears and wolves and wild-cats—could have gone in, too, but wild animals will not go near a fire. A big fire of logs burned in the fire-place.

What a wretched place to live! It was not much better than an Indian wigwam. The fire was the only splendid thing in the cabin. No, another beautiful thing was there. It was a pale young mother with a new baby. They lay on a bed of corn husks. It was raised from the floor on a frame work of poles. Over the mother and baby was a bear skin to keep them warm. The mother was not strong, but she was brave and sweet. She was glad the baby boy was big and strong, for he would have to work hard.

Presently, they had a visitor. It was a ten year old boy. His cheeks were red with the cold, and he was out of breath. He had run two miles, through the woods, to see the new baby. There were more wild-cats than babies in the woods of Kentucky. Besides, this baby was his cousin. He said that he was "tickled to death" to have a boy cousin. The boy was dressed in yellow deer-skin like an Indian. He wore moccasins, and a coon-skin cap with the tail hanging to his neck. A woman came and dressed the baby in yellow flannel and tow linen. She cooked some hominy and deer meat. She stewed some dried blackberries in wild honey. Then she went back to her own cabin, miles away through the woods. The boy stayed. At night he rolled up in a bear skin and slept by the fire place. The father went hunting so they could all have food.

Little boys had to grow up very fast in the back woods of Kentucky. When this baby was five years old he could catch fish, set traps for rabbits, get wood for his mother, and drop corn in the furrows, behind his father's plow. He went on coon hunts with men and dogs. He followed flying bees and found their honey in hollow trees. His father was a good carpenter, but nobody had

EMIGRANTS MOVING WEST IN COVERED WAGONS, OFTEN CALLED PRAIRIE SCHOONERS.



money to pay for carpenter work. He had to hunt, and fish, and grow corn, and chop trees and burn stumps. He had no time to put a floor in his cabin. The land was too poor to grow much corn. When the boy was eight years old the father said they must move a hundred miles away to get a better farm.

The mother packed everything that was worth taking with them, on the backs of two horses. The family walked. The big cousin drove a cow. The father carried a gun and shot game for their supper. When they came to the Ohio River they made a big raft of logs for a flat-boat. Even the horses and the cow went on the raft. The men pushed it across with long poles. The water was too wide and deep for the horses to swim. Then they were in a new state called Indiana.

They built a pole shack in the woods. A pole shack was a shed, open on one side. It wasn't nearly as good as a wigwam. The fire was outside. They lived in the shack a year. The boy was only nine, when the mother died, just as they got a good cabin built. Little, tired, wildwood lady! That life was too hard for her.

The boy helped his father and cousin saw boards from a green log to make a coffin. He whittled pegs to fasten the boards together. They had no nails. They buried the mother under maple trees, near where the deer came down to drink. The boy never forgot how his mother died. As long as he lived his eyes were sad, his lips tender. He pitied and loved and helped everything weak and helpless.

That lonely winter he studied his spelling book. His mother had told him that his grandfather came from good people in Virginia. She taught him to read and write. She told him he must study. By and by, a good stepmother came. She had three children so it was not so lonely in the cabin. She had a wagon load of tables and beds and chairs and blankets and dishes. She had a spinning wheel and a loom. The stepmother was a strong, kind, clever woman, who made everyone comfortable and happy. She found out that the boy loved books, and she helped him all she could.

He walked twenty miles to borrow a big law book. His cousin gave him a book of fables. He split cord wood to buy a little Life of Washington. He kept a book in the bosom of his checked shirt. At noon he sat under a tree and read a book, as he ate a dry, hard, corn dodger for his dinner. In the nearest village, he read a newspaper in a log store. When he grew up he knew more than any

man in the country. He could do more work, too, for he was tall and strong. He would not quarrel, and he made other men stop fighting. Everyone laughed at his funny stories. They wondered at his wise talk. He was so honest that he was called "Honest Abe." Now you know who he was. He was our great president, Abraham Lincoln.

Lincoln wanted to see the world. He went down the Ohio River, and on down the Mississippi River. He had no money for travelling. He went as a deck hand on a river boat. He saw the towns along the rivers, and the big, warm, French city of New Orleans. For a long time he thought he would learn to be a pilot, to guide boats safely on the big river.

When he was twenty-one Lincoln's father moved again. They went west into Illinois. They moved in covered wagons drawn by oxen. They drove for two hundred miles, through woods, across swamps and over the grassy prairies. The new home was built on a river bank. Lincoln helped his father build a cabin. He split rails to make a fence around the corn field. Then he left home to make his own way in the world. The women cried to see him go. The men gripped his big hand. They all loved him.

He went to clerk in a village store. It was a big, busy town of thirty log houses. The school teacher taught Lincoln grammar. He studied law by himself. He had no money to buy books. In a larger town, twenty miles away, were lawyers. They loaned law books to Lincoln. Still, he had to work for a living. He was a storekeeper and postmaster. He split rails, and he measured land, to mark off farms and roads. There were six years of hard work and lonely study, before he had learned enough to be a lawyer. Then he went away from the village to the state capital to live. More than twenty years later, when our country needed a brave, honest, wise man for a leader, in troubled times, it turned to this Western pioneer lawyer.

Thousands of boys were born in just such cabins in the woods. Thousands grew up into good and useful men. They made farms. They built towns and railroads. They were our great grandfathers. We are proud of them. But we are proudest of all of Lincoln. And we are proud of the worn-out mothers, who died so long ago of the hardships of pioneer days. If our great grandmothers could just have lived to know what men they gave to the world! See LINCOLN, ABRAHAM, page 1073.

X. WHAT "LIEBE MUTTER" BROUGHT TO AMERICA

Once upon a time a woman was packing everything, just as the Puritans did, to come to America. She was a German woman. The children called her *liebe mutter* (dear mother). She was like "the old woman who lived in a shoe, she had so many children she"—could not possibly leave one of them behind. There were at least ten of them. If you stood them in a row, with big Wilhelm at the head and baby Fritz at the foot, their yellow heads made ten stair steps. There was Frieda and Christine and Carl, Louise and Gustav and Minna, Gertrude and Otto. They all had very blue eyes, and very red cheeks, and very stout legs and arms.

Liebe mutter packed everything that was needed, and bundled up the children. Then she tucked something else in for the children. It was something every German child had once a year. The children of the King had it in the palace, and the children of the baron, in the castle on the rocks above the Rhine River. The children of the peasants who picked grapes in the baron's vineyards had it, too. It was the prettiest, the gayest, the happiest thing in the world. Sometimes it cost a great deal of money, and sometimes it cost nothing but loving thoughts and a little work. So you see the poorest child could have it, and the richest couldn't do without it. It was no trouble to carry it across the sea because it did not weigh anything, or take up any room in the ship.

Guess what it was! You have three guesses and a wish!

We don't know just where this German family went to live in America. A great many Germans came, and they lived everywhere. If they stayed in a city they had butcher shops and bakeries. Sometimes they had little del-i-cat-es'-sen shops, where they sold rye bread and sausages, cottage cheese and smoked fish and sauer kraut, and other good German things to eat. They had market garden farms and dairy farms in the country. Away out west, in the villages of logs, they had water mills and cooper shops and shoe shops, or they had big farms. Wherever they went they soon had good homes. They fed and dressed their children well, and put them in school and taught them to work. And wherever they went they took that gay, happy, beautiful thing for the children. They took it across the ocean, over the mountains, down the

rivers and out on the prairies. When the right time came they unpacked it.

There was just one right time. That was when the snow was on the ground and the sleigh bells were jingling. Then *liebe fader* went into the deep woods with an axe and a horse blanket. He came back after night, when the ten children were asleep under the feather-bed quilts. He stole into the house like a thief, and he smuggled a big horse-blanketed bundle into the spare room, and locked the door. Then he and *liebe mutter* laughed. They had a dear secret.

Everyone in the house had secrets. The children whispered and giggled and hid things. At last, one evening, the neighbors were asked to come in. They could come, just as well as not, for *they* had no secrets locked up in *their* houses. Then *liebe mutter* opened the locked door.

Oh, my goodness! Did you ever in your life see such a sparkling fairy of a tree? Candles blazed like stars all over it! It had strings of popcorn and strings of scarlet seed-hips of wild roses on it, and gilded nuts and cotton snow. There were wooden blocks and toys father had whittled, and leather balls, and rag dollies mother had stuffed and dressed. There were bags of molasses candy, and German honey and nut cakes, and gingerbread men and animals, and popcorn balls. Red mittens and scarfs were on that tree, and birch-bark work boxes, and feather dusters of rooster tails and—. Oh, dear, it would take a book to tell all there was on those first Christmas trees in America. And it would take another book to tell all that grew out of it.

You see, it didn't cost anything except a little work and loving thought, and it made everybody so happy! The neighbors went home from that Christmas joy in German homes, all over America, and they said:

"Next year, we'll have a Christmas tree, too, for the children."

XI. THE MIRACULOUS PITCHER

If the German people brought the Christmas tree to America the Irish brought us something for every day in the year. It was like the milk in the mi-rac-u-lous pitcher. No matter how much was given away the pitcher was always full.

You wouldn't think people so poor would have anything at all to give away. Why, they were so poor the children were hungry. There were Kathleen and Nora and Pat, Larry and Tommie and baby Mary. They lived in a little gray plastered cottage in Ireland. The floor under their bare feet was black earth, the straw roof leaked in wet weather. The farm was just one acre for growing potatoes. A lot of potatoes can be grown on an acre of ground if the weather is just right. But some years there was too much rain and the potatoes rotted. Some years there wasn't enough and the potatoes grew no larger than marbles. One dreadful year many people in Ireland starved. In thousands of cottages there wasn't enough to eat in September. It was plain the potatoes would not last all winter.

The black pot was not half filled, but it bubbled bravely above the peat fire in the open grate. The potatoes made a small heap on the bare table. Father and mother just pretended to eat so the children could have enough. The mother said she didn't care for new potatoes until they got old. That was an Irish joke. It made everybody laugh. Then the father said he would have to step across the sea to England and do some real work to get an appetite. There were two jokes, for the Irish sea was eighty miles wide, and he worked at home all the time. Kathleen gathered up the peelings and two of her own potatoes to feed the pig. Poor pig, he couldn't see the joke. When *he* was hungry he squealed.

Why didn't they eat the pig? They couldn't. He was "the good little fellow who paid the rent." When father sold him the money was sent to the great nobleman who owned the potato patch and the wretched little cottage. He lived in London. All the land for miles around belonged to him. Hundreds of such poor families sold their pigs to pay rent to him. He was very rich. Ship loads of corn were sent from America to feed people, and England sent food and money too. Still, of Ireland's eight million people, three million were hungry. It was hard to get enough food to them and some really did starve.

The Irish people have light hearts and merry tongues and loving words, and these helped them bear the hunger in the great famine. In thousands of Irish cottages it was pet names every other minute. When things were at their very worst fairy god-mothers flew over the sea by thousands. They were letters. In every letter was money. The money was sent by uncles and aunts and cousins, and big brothers and sisters, who had gone to America long before. All these letters said: "Use this money to come to America where there is plenty to eat." Why, that money was like the magic wand that turned Cin-der-ella into a princess. It bought new clothes and shoes; put roses into pale cheeks. It paid for a grand journey on the sea, and set them all down, right side up, in a new home in America.

The only tool the farmer needed was his potato spade. We were digging canals and building railroads then, in America, and any man who could use a spade could earn money. The Irishman was such a good worker, and so quick to learn new ways, that he was soon "boss" of the other men. The children were sent to school. Tommie became a lawyer, Pat the Mayor of the city and Larry a soldier. The Irish people always got up in the world when they came to America. In Ireland they had no chance.

Kathleen was a school teacher and all the children loved her. It was like Mary's little lamb. Kathleen loved the children, and she told them so. Do you know the good Puritans thought it wrong to love people too much—as if you could! And pioneer life was so hard it often made people hard, too. Wasn't that too bad? So, by and by, we forgot how to tell people that we loved them. Then the Irish people came over and showed us how. They scattered jokes and loving words around as free as sunshine.

Kathleen was a darling of a teacher. She had violet-blue eyes with smiles in them. She had red-brown curling hair, a merry laugh and golden freckles on her nose. When she wanted a child to do anything she'd say "Jimmie-dear" just as if it was all one word, or "Pet Marjorie" or "Honey Bee." The children just flew to do things for Miss Kathleen. Other people began to find out that they had loving words, packed away in their hearts and getting rusty. They took them out and polished them and used them every day. No matter how many they used they had just as many left. You see it was like the milk in the mi-rac-u-lous pitcher.

Wasn't that a nice thing to bring to America? See IRELAND, page 936.



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A HOSPITABLE HOME IN IRELAND.
"Fine day, sir, and welcome."

XII. THE GOLDEN FLEECE OF AMERICA.

Did you ever hear the old Greek story of Jason who sailed away to find the golden fleece? Many people think this a story of the world-old hunt for gold mines. Nearly every people has some such story in its history. We have one in our history. Some of your grandfathers can remember when gold was found in California. Some of them were Jasons themselves. They can tell you how they sailed away in prairie schooners (skoon-ers) in search of gold. Prairie schooners were not ships. They were covered wagons drawn by horses or oxen. The seas they sailed were seas of prairie grass.

Don't be ashamed to ask where Cal-i-forn-ia is. Sixty years ago grown up people had to ask where it was and how to get there. They found out that a bird in New York City would have to fly overland three thousand miles, straight west, to get to Cal-i-forn-ia. People wished they had wings too. On half of that land no white people were living. One thousand miles was over high mountains and deserts. It was a terrible journey. Still a great many people went. They thought they would be happier if they had more money.

Men left fields half plowed, houses half built. They sold their farms and shops. In the East they hurried to New York to catch ships, for you could go a long way around by sea. In the West they hurried to Chicago. Chicago was the most western city. It had twenty thousand people. There the gold-seekers bought horses and oxen and covered wagons. They bought flour and bacon and beans; blankets and clothing; guns and tools and water barrels. Eighty thousand men, some women and a few children really went to California in that way, the first summer after gold was found. They went in big parties because it wasn't safe to go alone. All the kinds of people who were in America went.

For five hundred miles west of Chicago there were small towns, corn and wheat fields and lonely cabins. Omaha was just a fort in the Indian country. Near it was a French fur-trading post. You remember the French children who came up the Mississippi, don't you? Then it was just wil-der-ness. The fierce Sioux, the Om-a-has and the Paw-nee Indians lived there. Great herds of buffalo fed on the high, dry, grassy plains. There were no trees at all except along the few wide rivers. But, oh, the flowers! Millions of them, red

and blue and yellow and white, starred the green or brown grass. The land climbed slowly for five hundred miles, until the plain was a mile above the sea. The air was very pure and clear. Fifty miles away people could see the mountains.

One morning the children climbed out of their beds in the covered wagons to see a wall of mountains. It stood nearly two miles high above the plains. Forests were up the sides, snow on the tops. It took days to cross these mountains through high, winding passes, although they were only twenty miles wide. Brown bears and black bears and grizzly bears were in those mountains, and big-horn sheep. In the wide valley behind them were elk and deer, coy-otes, a kind of small wolves, and villages of prairie dogs. After that came mountains again, and then the wide, burning desert.

Here and there, in the desert, was bunch grass for the horses and oxen, but most of the time there was nothing growing but sage brush and thorny cactus. Little rivers trickled through deep gorges. Sometimes the water was bitter with soda. Streams sank away in the sand. Coy-otes howled at night. Black buzzards circled around the sky. There were rattle-snakes and stinging scor-pions.

Whenever water was found the barrels were filled, and every drop was used carefully. Without water the horses and oxen died. Then, everything was left behind and people stumbled across the burning land. Some died on the way. Those who found water came to another steep mountain range. From the top of this they looked down a long, gentle slope. It was green with trees and bright with mountain brooks. At the bottom was a wide, green valley and a river. Gold, in little grains and lumps, was mixed with the sand and gravel in the river beds.

Mining camps sprang up all along the streams. The miners stood in the water. They scooped up pans full of gravel and sand and washed out the gold. A few men found a great deal of gold and became rich. Most of the miners found little. But very few people went home again. The journey was too hard. Besides, California had many other kinds of wealth. Today we call it the Wonderland of America. See CALIFORNIA, page 308.

XIII. ALICE IN WONDERLAND

Alice never forgot the time she went to California with her grandpapa. Grandpapa was going back to California. The first time he went in an ox-wagon, when he was ten years old. Now he was going back from New York City in a palace car. Grandpapa was seventy and Alice was ten. She was young enough to be foolish, and grandpapa was old enough to forget that he had ever been wise. So they went to California together, and they had a perfectly grand time.

Part of the fun came from grandpapa's pretending. You know a great many grown people can't pretend a bit. Grandpapa pretended that everything would look as it did when he was a boy. He told Alice Chicago would be a little city of twenty thousand people. He asked the colored porter of the car how big it was.

"'Bout two million people, suh!"

"My, my, how it has grown since I was a boy," said grandpapa. Alice laughed and grandpapa's eyes twinkled. He pretended to be surprised all the time. Om-a-ha was a big city too. There was no fort, no fur-trading post, no Indians, no herds of buffaloes. The grassy plains were covered with wheat and cornfields and busy towns. In front of the mountain wall was Denver, a city of more than one hundred thousand people.

The iron horse climbed right over the mountains. The railroad looped around the curves. It ran along the edges of cliffs, and through long snow-shed tunnels. "Now," said grandpapa, "you'll see bears that *are* bears. Don't the bears come down to the stations, and give you bear hugs, sometimes?" he asked the porter.

"No, suh, not that I evah noticed, suh. I reckon they done gone fah back in the mountains, suh!"

"Too bad, too bad," said grandpapa. "No bears, no big-horn sheep, no deer, no elk. Well, hello, there are some prairie dogs, barking at the train!" There were a few Indians at the station too, and flocks of woolly sheep on the mountain sides, with shepherds and collie dogs, and in the valleys were cattle, and cowboys on ponies. The snow peaks were there, and the dusty desert. But every once in a while they came to a mining town high up on a

shelf of rock, or a green valley with canals running through farms. The water had been brought down from the mountains to make the desert bloom. In the very driest part of the desert they found Salt Lake City, with sixty thousand people, in a big valley between mountains. The valley was all farms and orchards. The city streets were shaded by great trees, the houses set in green lawns. The train ran right across Great Salt Lake, twenty-five miles. Bathers were in the lake. They bobbed around like corks. The water was so salt they could not sink. The train climbed another steep mountain range, then slid down a long toboggan slope, through forests.

"Now," said grandpapa, "I know where I am. I'll show you where I helped my father wash gold out of the gravel in the river bed. It's just below in the valley."

This time he wasn't pretending. He really thought he could find the place, but the mining camp was gone. Gold mining was done up in the mountains. It was done in mills that crushed the gold-bearing rock. The river banks were lined with towns and farms and golden wheat fields. On the hill sides were flocks of sheep. The river grew wider. It met another river flowing north. They ran together and into wide water.

"Where are they going now?" asked Alice.

"Through the Golden Gate, to where the sun sets."

There was a big city built up the hill sides above the water. At its feet lay a wide harbor full of ships. Across the harbor they looked through a narrow strip of water walled with rocks. It was like a thick stone gate. Through the gate they saw the sun set in a great ocean. The city was called San Francisco. Its nickname was City of the Golden Gate. Alice wondered what lay out there over the wide water, where the sun set. She asked if they could get one of the ships and go to see.

"By and by, when we have seen the City of the Queen of the Angels."

Alice hugged herself. This was as good as a fairy story. She hadn't the least idea how it was coming out. Have you?

After they left the City of the Golden Gate they saw mountains two miles high, with lakes at the bottoms of their dark green pockets. They saw rivers sunk half a mile, and lined with steeples and towers of rock. Then they came to the Valley of Delight. Grandpapa called it Yo-sem-i-te Valley. There they left the train and got on a stage coach. One whole day Alice rode on a donkey.



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DENVER AND THE MOUNTAINS

Here is beautiful Denver, as Alice saw it "in front of the mountain wall," and the railroad that "loops and runs along the edges of the cliffs."

They slept in a camp hotel. The valley was a mile deep. It was walled with mountains. Rivers fell from the tops of the cliffs. They tumbled after each other like Jack and Jill. A river jumped down a quarter of a mile. That was such fun, that it took a little run over rocks and jumped again. It played hide-and-seek and follow-the-leader and leap-frog down the rocks. Sometimes a falling brook spread out in a broad sheet. Sometimes it fell so far that it turned to spray and looked like a bride's long veil. The sun shone on the spray and turned it to rainbows.

Alice had no time to catch her breath before the next wonder. This was trees more than three hundred feet high and thirty feet thick. She had to lie on her back to see the tops of them. The trees looked very, very old. She thought they must have been born in the days when giants lived.

"Were they here when Columbus came to America?" Alice asked.

"Oh, yes, some of them were eight hundred years old when Columbus came."

Dear, dear! Alice wondered if they weren't tired standing and holding the blue sky up so long. Little white clouds seemed to be tangled in their evergreen leaves.

The farther south they went the warmer and dryer it became. Still there were wheat fields and sheep. By and by there were orchards of gray-green olive trees, and vineyards of big white grapes on gravelly hillsides. Some of the farms had queer houses of sun-dried yellow bricks, and with flat roofs. Many of the people were darker, with big black eyes. Every town and river was called "San" or "Santa" something. Grandpapa said that was Spanish for Saint.

Why, how did the Spanish people ever get away over into Southern California? Alice asked a sheep rancher that, as she drank milk and ate figs as sweet as honey in the patio of a farm house. Do you remember the patios in the houses in Cuba? He took off his broad-brimmed, gold-laced, pointed hat very politely, and said that he did not know. They had been there a good while. Then she asked a priest at an Indian mission church. He said the Spanish people came up from Mexico to live, many, many years before gold was found. The Spanish people made a garden out of the desert. They brought seeds and plants from Mexico, and they coaxed water down from the mountains. Many of the gold seekers did not go back home. They went down the valley five hundred miles to the Spanish towns, and they made more farms and towns near the sea around

Los Angeles. The Spanish had built a town there of sun-dried bricks, and called it the City of the Queen of the Angels. Now it was a great, rich American city of three hundred thousand people.

No wonder the Spanish people called it that! For hours and hours the train ran south through fairy land, and into summer weather, although it was Christmas time. It ran through orchards of orange and lemon trees, through grapes and figs and plums, through groves of almond and walnut trees and olives. The towns were hidden by trees, the houses covered with roses. There were palm trees, and hedges of ger-an-i-ums, ten feet high.

Right over the city of Los Angeles were mountains with snow on them. A real Christmas tree was brought down from the mountains. On New Year's day there was a flower festival. Hundreds of carriages and au-to-mo-biles were covered with roses. Flower fairies rode in open cars. Alice was a white orange blossom in a bride's wreath of little girls. Thousands of people watched the flower procession. Alice was so happy she couldn't sleep a wink that night. She wanted to live in the City of the Angels forever. See CALIFORNIA, page 308, SAN FRANCISCO, page 1671, and LOS ANGELES, page 1116.

XIV. THE CHILDREN OF TOPSY-TURVY LAND.

Wouldn't you like to visit some children who never cry when they are babies? No, they are not Indians, although they ride around on their mother's backs. Their faces are yellow. Their almond-shaped black eyes are slanting. They wear ki-mo'nos. They wipe their little noses on little paper handkerchiefs that they carry up their wide sleeves.

Japanese children! You have seen them in picture books. But how shall we really go to see them?

Let us go back to the City of the Golden Gate. One part of it is like fairy stories. The fronts of the shops are covered with red and gold dragons. This is called Chinatown because the Chinese people live there. If we hunt a long time maybe we will find a Japanese shop. The merchant is yellow, like the Chinese, but he wears American clothes and cuts his hair short. He speaks very good English. We will buy some tea, or a roll of silk, or a blue and white china bowl. If we are very polite, and we tell him we are going to get on a ship and go to Japan, perhaps he will give us a letter, and ask us to call on his brothers and sisters in Tok-io. Won't that be fine to visit Japanese children in their own home?

We get on the big steamship. It is not like the little sailing vessel—the Mayflower—that the Puritan children came in, three hundred years ago. It is a floating hotel, six stories deep, a hundred feet wide and as long as a city block. We sit on the roof of the ship. It is called the deck. The ship plows its way across the ocean. It goes very fast, but it takes days and days to get to Japan because this ocean is nearly five thousand miles wide. When we get to Japan we notice a strange thing. We may look back over the ocean we have crossed and *see the sun rise!* Japan is called the Land of the Rising Sun. The big rising sun is on all the Japanese flags. They float from ships in the harbor, and from tall houses in the city.

Here come the children, down to the dock, to meet us! They look just like their pictures. They are all dressed alike in blue or gray or flowered cotton ki-mo'nos, down to their straw or wooden sandals. We have to turn them around to see which are boys. The girls tie their sashes in big butterfly bows. The boys tuck in the

ends. And the girls do up their hair like mamas. The ki-mo'nos are not pinned or buttoned. They are just folded across the front. To keep the ki-mo'nos from flying open the children take short steps and walk pigeon toed. The biggest girl carries baby brother on her back. He is just as interested in what is going on as anybody. The children all smile, and bow very low. It is not polite in Japan to look unhappy or to say cross words. In a minute a little girl will rub her velvety, gold-colored cheek against yours. That is a Japanese kiss. She will put her arm around your waist. Then you are dear friends. She will want you to ride in the same jin-rik-i-sha with her.

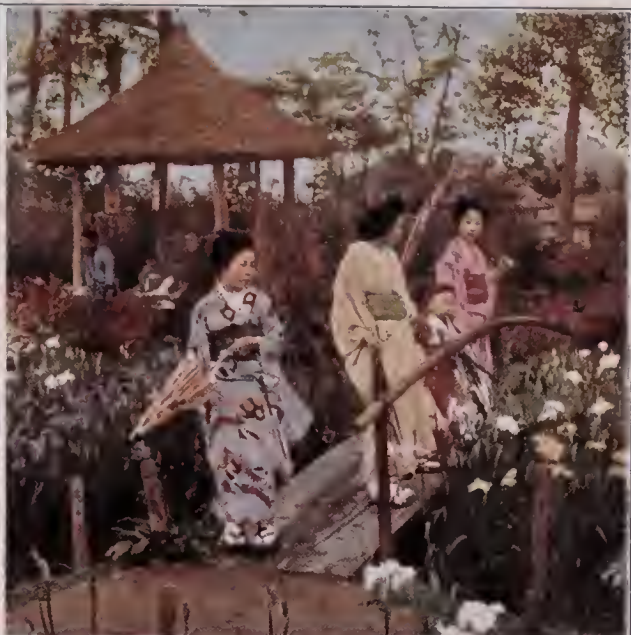
Jin-rik-i-shas are like big baby cabs on two wheels. They are pulled by men. The men wear blue or white cotton, butter-bowl hats on their heads, very short, tight breeches and loose shirts outside. In the jin-rik-i-sha you feel like twin baby sisters out with the nurse maid for an airing. You giggle, and your new little friend giggles. Then you ask her name. She says it is Cherry Blossom. That seems too good to be true. Her brother's name is Nogi after a great war hero.

How fast the jin-rik-i-sha man runs—as fast as a horse. He whirls you through the queerest streets. The houses and shops are of gray wood, with heavy, over-hanging roofs of black tiles. They are wide open. The walls are slid back so you can see everything that is going on inside. By and by you come to the children's house. They all kick off their sandals and go in in their stocking feet. No wonder, with such clean white straw mats on the floor! You take off your shoes, too. They are so troublesome you think you will get some Japanese sandals to wear.

What a funny house! It has no windows, no doors, no rooms. The walls slide back to make just one room, and that is open clear through as if it was all out doors. There are no chairs, no beds, no tables. The parlor is at the back of the house. That is the prettiest part because it looks into the prettiest little garden you ever saw.

There is a little hill, and a little river with a tiny bridge across it. There is a little lake with gold fish, and tiny twisted old pine trees. There is a little tea house in the garden. You sit on your heels before little tables a foot high, and a little maid brings tea on a tray. You drink out of dolly tea cups.

Every minute there is something new. The children stop a toy stove peddler and rent a real stove with a charcoal fire in it. You



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SCENES IN JAPAN

FROM STEREOGRAPH © H. C. WHITE CO., N. Y.

1—Peasant and Mt. Fujiyama. 2—Flower garden. 3—Babies and big sisters. 4—Jinrikisha men and cherry blossom time. 5—Japanese Bed. 6—Combing out flax seed.

can have it for an hour for five cents with rice flour dough to bake cakes on it. The girls bring out their dollies. The dollies look just like themselves. The boys fly kites. The kites are shaped like fish balloons, like dragons and butterflies and animals. They play something like pussy wants a corner, and a card game like authors. They call this the game of the one hundred pocts. Verses are on the cards and you have to learn them to play well.

At dinner the family sits in a circle on the floor. Each person has a little stool for a table. The maid brings food on little black and gold trays, one thing at a time. There are no knives or forks or spoons. You eat with long ivory pencils called chop-sticks—if you can. You drink soup from cups. Candy and sweet things are brought first. Then you have fish with pineapple sauce, then salad and hard green pears, then rice and tea. There is quite a peck of boiled rice in a round wooden box, with a cover to keep it hot. Rice is Japanese bread. You may eat all you want. If you drop your chop-sticks or break a cup, everybody will laugh and begin to talk about something else very fast. They know you feel bad about it and it wouldn't be polite to notice an accident.

At night the maid slides the walls in place around the house. Then she pulls out more walls, and makes as many bedrooms as are needed. She opens cupboards in the walls and tumbles out dozens of soft thick comforters onto the floor. That makes a bed. You use the top comforter for a cover. She gives you a wooden brick for a pillow. Little Cherry Blossom giggles when she sees your surprised look. But she rolls up a quilt to make you a pillow. She lies down beside you, tucks the block under her own neck and goes sound asleep in a minute.

Before you leave Japan you must go to visit a Japanese school with your little friends. You find they have forty-seven letters to learn, instead of twenty-six. And they have thousands of word signs, that look like very queer, black, bird-tracks. They write with a paint brush. Their books begin at the back, and the reading goes up and down instead of across the page. They sit on mats on the floor, in their stocking feet. They count with wooden beads strung on wires in a slate frame. They have to learn English, too. They say English is the hardest to learn of all their lessons, because it seems upside down.

If you go to Japan in the spring you will see the cherry trees in bloom, and the pear trees and plum trees. The Japanese grow

fruit trees in their little toy gardens just for the blossoms. They have a flower festival when the trees are in bloom. Everybody writes little poems about the flowers on rice paper, and ties them to the trees. Isn't that a pretty thing to do? People try to stay out of doors, in big parks, all they can, in cherry blossom time. They go up the mountain sides where miles of trees are in bloom. They take picnic lunches in little straw boxes. They carry paper parasols for fear it might rain; and when they come home at night they carry red paper lanterns to light the way.

Sometimes Japan is called the Flowery Kingdom. It might be called the land of polite people, or the land of happy children. What would you call it? See JAPAN, page 960. MUTSUHITO, EMPEROR OF JAPAN, page 1292, and *Oriental Art* in article on FINE ARTS.

XV. ALL WORK AND NO PLAY FOR LITTLE WUNG FOO

If Wung Foo had studied very hard at school, and learned as many as twenty-five new sign words, his grandmother told him stories in the evening. Wung Foo was a little Chinese boy, eight years old. His father was a rich silk merchant in Canton, China. His grandmother was a little old lady. But she wore such rich clothes, her face was so carefully painted, and she had so many jewelled pins and flowers in her hair, that she looked quite young. Wung Foo was proud to have her lean on his shoulder when she wanted to cross the room. Her little crippled feet were only four inches long.

Chinese stories for children are the scariest kind. They are all about witches and goblins and dragons. They did not scare Wung Foo, as long as his grandmother talked in her sweet, sing-song way. Besides, his mother, his aunts, his sisters, his girl cousins and his baby brother were there in the women's sitting room. Wung Foo was a visitor. He lived on the men's side of the house.

Wung Foo had a chubby, yellow face and slanting black eyes, like Japanese Nogi. He, too, pushed a great deal of rice into his round mouth with chop-sticks, and drank many little cups of tea. In most other ways he was very, very different from Nogi. Nogi was always laughing, but Wung Foo was a sober little fellow. China isn't nearly as pleasant a place for children to be born in as Japan.

Wung Foo looked very fat in the winter time because he had to wear such thick, quilted cotton under-clothing. There were no little brass box, charcoal stoves, as in Japan, to keep the house warm. And there were no soft mats on the cold brick floors, so his gold trimmed, red cloth shoes had thick, white felt soles. He wore loose trousers of red silk, folded around his ankles, and a padded blue silk coat fastened with gold buttons and cord loops. He kept his round cap on, even in the house. His head was shaven, all but a thick black lock on top. The barber braided some long, black silk threads with the hair, to make a queue (cuc) like his father's, and left a pretty silk tassel at the end. By and by his hair would be long. Then he would not need the silk. The little boy was a small copy of his grandfather.

Wung Foo's little six year old sister was a small copy of her grandmother. She was dressed almost like her brother, but her silk trousers hung loose, like a divided skirt. She lay on cushions, on a bamboo sofa, with her bound feet under her. Sometimes she cried with pain. When grandmother told a fairy story she always said: "The beautiful maiden had such tiny feet that a mandarin's son married her." Then the little girl stopped crying. By and by she could wear satin shoes four inches long, and have her face painted, and dress her hair with flowers and jewelled pins, and very likely a mandarin's son would marry her. Of the hero, grandmother always said: "He learned all the thirty thousand sign words, worshiped at the tombs of his fathers, and became a rich merchant." Wung Foo made up his little mind that he would be very good and study hard.

A Chinese house is just as shut up as a Japanese house is wide open. Wung Foo's home had a wall around it. It stood in a garden, with a lily and fish pond, a bridge, and a curly-roofed tea-house. The women's sitting room was very pretty. It had stools and tables of carved black wood, inlaid with pearl flowers. On the walls were hung pictures embroidered on red satin, or painted on rice paper. There were vases and jars of red and gold, and blue and white. The tea trays were of silver with gold birds on them. The ladies opened and shut scented fans. They spun flax, embroidered on silk and linen and played dominoes. They had pet gold fish and singing birds. They ate a great many sweet things. When they visited other ladies they went in sedan chairs. Sedan chairs are cushioned and curtained and gilded boxes. They have four poles and are carried by men servants. The ladies could not see out of them, very well, or be seen. That was too bad, for the streets were very crowded and gay.

When Wung Foo went to bed in the men's room, he pulled a down quilt over his head. He was only a little boy, after all. In the dark the goblin stories scared him. In the morning he was awakened by a thousand noises. Watchmen told the hour on bamboo drums. Beggars beat on the gate with sticks until a servant went out with rice. Peddlars cried out that they had fish and ducks and eggs and fruits and fat puppies, to sell. A procession banged and rattled and squealed Chinese music. Wung Foo thought it was very sweet music. China had always had it. China never changed anything. He thought the old ways of doing things the very best ways in the world.

One very old way of doing things in China is for little boys to go to school before breakfast, and to go nearly every day in the

WUNG FOO'S WORK AND PLAY



These Chinese school children are playing a Chinese game called "The Dragon Head." On your right is a Chinese boy who earns his living by street exhibits of sleight of hand, such as spinning plates.



The Chinese in cities buy water of these native carriers. That Chinese farmer raises poppies from which opium is made that is the curse of his people. See his opium pipe?



For a fraction of a cent you can have a "street-car" like this all to yourself in China. It is the native Sedan chair and is quite comfortable to ride in.

year. The only vacations are at New Years, in February; on kite flying day in October, and on the feast of the lanterns day. Then fire-crackers pop and snap and bang all day long, as they do on our Fourth of July. When Wung Foo went to school there were a thousand interesting things in the crowded streets, but he never noticed them. He walked along gravely. When he met his schoolmates he shook his own hands inside his sleeves to show that he was glad to see them. The school was much like a Japanese school, except that the boys sat on stools, with higher stools in front for tables; and the teacher was very cross.

At ten o'clock Wung Foo came home for breakfast. At four he came home for dinner. It was a very good dinner of bird's nest soup, fish, duck eggs, chop-suey, rice and gam-got. When chop-suey is made of bits of chicken, ham, water chestnuts, mushrooms, celery and crisp little barley sprouts, all fried together in peanut oil and dressed with spicy brown sauce, it is very good indeed. Gam-got is little preserved oranges about as big as plums. Sometimes he had chrys-an-the-mum fritters, of the flower petals, with pineapple sauce.

Once Wung Foo went on a journey with his father. He went on a boat up the river. The river was so wide there was room for sail boats in the middle, and for streets of house-boats along the banks. Women washed and cooked on the decks of the house-boats. Children played there with little barrels tied on their backs. If they fell into the water the barrels kept them afloat until some one could pull them into the house again. The people who lived in house boats were poor. Boys no older than himself tended ducks in the marshes. Others fished with big birds that were trained to dive. They were all barefooted. The little girls had big feet. They would always have to work.

Wung Foo saw other little boys and girls picking cotton bolls, and tea leaves, and mulberry leaves to feed silk worms, and planting rice in wet ground. He saw them bending over cotton and silk looms, and carrying heavy jars and tiles at the pottery works. They worked for a few cents a day. They lived in huts and ate nothing but rice and a very little fish, and drank the poorest tea. When he went back home he studied harder than ever. He was glad he was going to be a mandarin, or at least a silk merchant like his father. Perhaps he might go away to be a merchant in Chinatown in San Francisco, America, or to Manila, in the Philippine Islands. But when he got very rich he would go back to China. See THE CHINESE EMPIRE, page 389.

XVI. ALL PLAY AND NO WORK FOR MANUELO

Manuelo was a little brown Filipino boy who played nearly all day long. He did not care how many Chinese boys came to his home in The Philippine Islands to be rich merchants. It seemed very foolish to him for anyone to work so hard when it wasn't at all necessary. A cocoanut shell full of rice, and a banana that he could pick from a tree made a very good breakfast. As for clothing, he wore nothing except when he went to the American school. He was a good-tempered, polite little boy. When he went to school he wore white cotton trousers and a jacket, to please the American lady teacher.

There were many things that puzzled Manuelo. He was a Filipino boy, but his name was Spanish. His language was a mixture of Spanish and his native tongue. Now the lady teacher told him he was an American boy. In the school he was learning to read English. Let us see if we can straighten out the puzzle for him.

Four hundred years ago the Spanish people, as well as the English and Dutch, were great sailors and conquerors. About thirty years after Columbus found America, another Spanish explorer named Ma-gel-lan, found a large group of three thousand big and little islands. They were away over near China. He called these islands The Philippines, after the Spanish King Philip. The Philippine Islands belonged to Spain until a few years ago. Manuelo was a baby when there was a sea-fight in the harbor of Manila. Manila is the largest city on the islands. The fight was between Spanish and American ships. After that The Philippines belonged to the United States. The Spanish soldiers went home. There was a new flag of red, white and blue. The military bands played gay new tunes. Then the lady teacher came. For the first time, little Filipino boys and girls were expected to go to school. You see now how the little brown boy became an American. There are four colors of Americans—red, white, black and brown. You will like to know the little brown American boys and girls better.

Manuelo was small. He would never grow to be a very large man, but he was straight and slender and graceful. His short black hair was straight. His bright black eyes slanted just the least little bit. His lips were thin and red. He was very clean, for he swam



HOME LIFE OF FILIPINOS IN THEIR THATCHED HUTS.



From Stereograph, Copyright by H. C. White
PRIMITIVE FILIPINO SCHOOL HOUSE.

in the sea, or in the nearest river, every day. There are no crocodiles in the rivers of The Philippines, but there are sharks in the sea. Manuело had to stay in shallow water near the shore.

Our little brown cousin lived in a village of Nipa palm huts, under feathery palm trees. His father's house was built of bamboo. It was raised from the ground on thick, bamboo posts. It was thatched with Nipa palm leaves. Underneath the house was a room for the chickens, the pigs and the water buffalo. They all made a great noise in the morning and woke the family up. The light woke them up, too. In the walls of the house, were sliding windows set with thin, pearly squares cut from oyster shells.

Manuело helped himself to all the rice he wanted from the red earthen cooking pot. He took a banana, an orange, a mango, a pineapple or any fruit he liked best. When he had eaten his breakfast, he tumbled down a bamboo ladder to the garden. The garden was gay with flowers and fruit trees. A thornbush fence was around it.

If no playmates were in sight, Manuело knew where to look for them. He ran first to the Plaza. Plaza is Spanish for open square. The church and the priest's house on the Plaza were as Spanish as those of Cuba. They were colored lemon yellow, and had roofs of red tiles. A few shops, and the best Nipa houses of the village were on the Plaza. Market was held there some days, and the village band played there in the evenings. In the early morning the Plaza was empty and quiet. Thick, dark forests were behind the village. The woods ran up a mountain slope. From the bare top of the mountain, blue smoke curled. The mountain was a volcano. Sometimes the volcano made the earth tremble.

Manuело ran down a street of Nipa huts to the river. The women of the village were there washing clothes. His sister Juanita (Wanee'ta) had a bamboo basket of pineapples on her head. She was going to the big market in Manila to sell them. Juanita was pretty. She wore a red skirt, and a white lawn jacket with wide sleeves. She smiled at Manuело and he slipped into the river. He swam and paddled and dived with forty other children for an hour.

In another part of the river were the water buffaloes chewing their cuds. They looked like clumsy, long-horned cows with thick legs, humps on their backs and skins like pigs. They were plastered with mud. You would think them very ugly, indeed, but they were good-tempered, useful animals. They plowed the rice and hemp and cane fields; they drew the heavy, two-wheeled carts to market,

and they gave milk. Manuëlo called his father's water buffalo by a pet name. The little boy climbed up on the animal's hump, held fast by her long horns and had a ride in the water.

When Manuëlo went home with his mother, he brought her a bamboo pail full of water from the well in the Plaza. He cleaned some rice for dinner. He put some grain in a wooden trough and beat it with bamboo, to loosen the brown hulls. Then he tossed it in the air to let the chaff blow away. He caught the grains in a basket. Sometimes, in the spring, he helped plant rice. He waded in the mud and water to set the plants in rows. You know rice needs a lot of water to grow in. He made fish nets of split bamboo and hemp.

Manuëlo learned to make all sorts of things of bamboo. Perhaps you have a bamboo fishing pole, and you know how light and strong it is. It is hollow inside, and has solid joints. Bamboo is really a kind of grass that grows very thick and tall. Some of the canes are as small as a pencil; some as thick as a man's leg. In The Philippine Islands bamboo grows wild, and the Filipinos use it for many things. Bamboo is used in building houses, carts, bridges, ladders, boats and for water pipes. Split into thin strips it is woven into awnings, baskets and hats. The tender young shoots are good to eat, as we eat celery. If a Filipino is very clever, and is willing to work a little, he can have a very good house and cart, boat and baskets for nothing. And it is no great misfortune if an earthquake shakes his house down. He can easily build another.

Best of all, Manuëlo liked a day in the forest, on the mountain slope, hunting bread-fruit, figs, nuts and eggs. The woods were thick and damp and hot and still. Ferns grew as tall as little trees. The palms seemed to touch the sky. The trees grew close together. There were big, twisted and thorny bushes. In the woods were ever so many curious things. There were the mounds that birds built to hide their eggs. There were tailor-bird nests that were bags of thick leaves, *sewed* with spider webs. The tailor-bird used his sharp bill for a needle. Bats hung by their wing-hooks, and fanned themselves. Monkeys chattered and quarrelled and ran races through the trees. There were orchids (or'kids), great wax butterflies of blossoms, that grew on tree trunks, and fed on the air. Other things were not so pleasant. There were stinging ants and insects. There were snakes that could squeeze little boys to death, and poison snakes. But it was not often that a little Filipino boy got hurt. A number

of boys always went together, and they all kept their bright eyes and their sharp cars open.

If Manuelo's father sold his fish for good prices, he bought a white cotton suit of clothes for Sunday, or a shell comb for his wife. Manuelo's mother and sisters could make good clothing, for every day, of hemp and palm threads; and a very fine, silky gauze of pineapple fiber. But Juanita liked the bright calicos in the Chinese and American shops. She sold her fruit in the market and bought gaily colored skirts and ribbons and slippers.

In the evening, Manuelo's family sat in the open door of the house, and on the rounds of the ladder, below. Big fireflies flitted in the dark garden. They could smell the flowers and fruits. The father played a new tune on his guitar, and Juanita danced. Sometimes his father played with the village band in the Plaza. On feast days, there was a church procession with beautiful tall candles and banners. Fire crackers were snapped and rockets sent up. On dark nights, the sky above the volcano was often rosy with the fires far down in the heart of the mountain.

In the house a light burned all night. The lamp was a cocoanut shell full of oil. A light might be needed at any moment. When an earthquake shook a house, everybody must scramble down the ladder in a hurry. The animals ran out from under the house. The chickens squawked, the pigs squealed, and the water buffalo mooed. The whole village of people and animals tumbled out of doors. When the trembling stopped they all went back to bed again. Manuelo turned over and over on his bed of palm leaves. He was kept awake so long that he thought perhaps he wouldn't wake up in time to go to the American school in the morning.

That would worry the lady teacher, but it wouldn't worry Manuelo. See *THE PHILIPPINE ISLANDS*, page 1469.

XVII. CHILDREN OF "THE ARABIAN NIGHTS"

You have taken a long journey since you sailed through the Golden Gate at San Francisco. Now it is time to go home. There is more than one way of going home from school, and a lot of things to see on the way. So, when you are in far away lands, there is more than one way of going home to America. Don't you want to stop, on the way, to see some children who live in a desert? They live very differently from any people that you could find anywhere else in the world. They have two things you like very much—no, three. They have sugary dates to eat, and big humpy camels and dromedaries to ride. What is the difference between a camel and a dromedary? And they have Arabian night's stories.

If you want to see Mehemet and Zaidee in their tent home in Arabia, you must call upon them very early in the morning, or after the sun goes down. From noon until four or five o'clock, when the burning sun blazes on the yellow desert sand, there seems to be no one living in the big tent. The tent is quite forty feet long, because the father of these children is a Sheik, or Arab chief. It is covered with brown camel's hair cloth, or with black and white goat skins.

It stands on a few acres of grass, under some tall date palm trees, beside a spring. The spring makes a green spot in the desert. All around that green place are miles and miles of dry sand. The sand dazzles your eyes, so you think you see other green places and palm trees and blue water. But these are only air pictures that fade away. The sand is blown up by the wind in great drifts, like yellow snow. In the shadows of these drifts and of big rocks, camels and sheep and goats lie asleep. The herders and sheep dogs are asleep among them.

If you should lift the door flap of the tent you would see a white curtain hung across the middle. This divides the big tent into two rooms. The men and boys are in one room, the women and little girls in the other. It is dark and cooler inside the tent. You must step softly, for everyone is asleep. They lie on colored mats and saddle-bag cushions. These are made of O-ri-en'tal or Eastern rugs. American people buy these rugs for their very best rooms, if they have enough money. The Arab chief buys them in the Turkish city

ARAB LIFE IN THE DESERT



Arabs can ride at full speed on their wonderful horses and, at the same time, aim and fire their guns.



Here is a group of tents in the desert that the Arab child calls "home." Notice how they differ from Indian tents.

ARAB IN THE DESERT PREPARING TO PRAY



HIS LEG IS TIED. HE CANNOT WANDER



When praying, Arabs first kneel, touch the ground with their foreheads, as these natives of India are doing, then rise with hands uplifted toward Mecca, the birthplace of Mahomet, their prophet. The natives of India are Buddhists. (See Buddha (bood'á.)

where he goes to sell his camels and his wool. He has had to pay a good deal for them, but they will wear several life times. Besides, they are the only kind of beds and seats he can carry with him. He has to move about a good deal to find food and water for his animals. He loves the rugs for their beautiful colors and patterns. Can you guess why?

Every one is asleep but Sal'adin, the master's Arabian horse. Saladin stands beside his sleeping master in the tent. He is small and dainty. His coat is like black satin. He holds up his proud head on his arched neck. He stamps his little polished hoofs on the sand. Saladin is the family pet. He is very gentle. He skims over the desert like a bird, with his master on his back. Mehemet gave him some dates to eat before he went to sleep. Zaidee kissed his black nose.

At sunset, a cool breeze blows across the desert. Everybody wakes up and sits on the mats outside the tent. Mother brings her loom to weave camel's hair cloth. The herdsmen milk the camels and goats. A servant woman makes mocha coffee. It is the best coffee in the world. The children drink goat's milk. They all eat crisp bread cakes like our crackers. They are made of wheat, barley or millet seed flour, and baked on hot stones. They eat a stew of goat's flesh or mutton. For dessert they eat dates and almonds.

Zaidee is very pretty. She would not be so very dark, but the hot sun has burned her as brown as a gypsy. Her hair is black and straight. Her soft, almond-shaped eyes are the color of brown velvet. She wears wide trousers and a loose gown of blue cotton. On her head is a blue cloth, bound into a long-tailed bonnet-cap, with a band of goat's hair. She has copper and silver bracelets on her arms and ankles, and strings of glass beads. Her brother wears a long white shirt with a leather girdle, and a white cotton bonnet bound with goat's hair. When they walk on the sharp, hot sand, they both put on leather sandals. The father wears a white turban made of many folds of thin stuff wound around his head. He smokes a pipe.

Sometimes, as the family sits in the starlight, the father or mother tells stories like those you read in the Arabian Nights. Perhaps, because of their dull lives in the dry and barren desert, the Arabs have made up the most wonderfully colored and fanciful stories of any people in the world. Their stories are full of the splendors of palaces and princes. They sparkle with jewels and are woven of

magic. The children of every people in the world listen to these stories with wide, wondering eyes. Perhaps, too, that is why the desert people love the many-colored, gaily-patterned rugs. Spread on the sand they look like flower beds.

As soon as the moon is up, the herders take down the big tent. The water is dwindling in the spring, the grass is almost gone. The family must move to a better pasture. They must go at night, when it is cool. Everything is packed on the kneeling camels. Skin bags are filled with water and bread and dates, for the journey. One by one the animals take a last drink at the spring. The camels fill the little water pockets in their stomachs, to last for several days.

Saladin, the proud bearer of his long-bearded, white-turbaned master, leads the procession. Then come the women and children on the riding dromedaries. The freight camels follow with their drivers; the brown herders and dogs drive the sheep and goats. The moon is a silver crescent in the dark blue sky. The stars are little high, white lamps. The padded feet of the camels make no sound. Camels are called ships of the desert. They swing and rock like ships across the sea of sand.

The procession grows smaller and dimmer in the distance. Now it goes over a great ridge of drifted sand and disappears. Mehemet and Zaidee are gone. But you will never forget this vast plain of white sand under the dark blue sky. It lies there so wide and silent and lonely, under the silver light of the moon and stars. See *Camel, Arabia, Arabian Stories* in article on LITERATURE, "*What is a Mirage?*" in WONDER ITEMS, and "*The Ship of the Desert*" in WILD ANIMALS.



PAINTED BY THOMAS MORAN, A. N. A.

THE HARBOR OF VENICE

"Soon you come to a third city where water streets are lined with palaces." Mr. Moran's famous sea scapes have earned him the title of the "American Turner."

XVIII. THE LITTLE COUNTRY OF THE BIG MOUNTAIN

After you have watched the ships of the desert sail away across the sea of sand, with Mehemet and Zaidee, you go down to a seaport town and get on a real ship. It steams for hours between yellow deserts. Then, all at once, it comes out through a canal, into the warmest, bluest big sea, dotted with the greenest islands and bordered by the greenest shores. The ship stops at many cities, everyone of them different, with different kinds of people.

In Athens the people are Greeks. Long, long ago the Greeks built the marble temple whose broken columns you may see on the hill. They wrote poetry and made up stories that we read today. They made marble statues so much more beautiful than any people have made since that we put plaster copies of them in our houses.

The Turkish city of Con-stan-ti-no-ple seems to be all round domes and tiny spires. In the shops there, you could buy the beautiful rugs the Arab chief had in his tent. Soon you come to a third city, where water streets are lined with palaces. That is Venice, in Italy. The dark, handsome young men in knee breeches, wide hats and red sashes, who stand up to row the swan-like boats, are Italians. The boats are called gon'do-las. As the Greek people of the old days made temples and statues and poetry, so the Italians built beautiful churches and palaces, and painted wonderful pictures and wrote more poetry.

You will not have time to stop in these places. Besides you will see all these people again, and all together, in the strangest place where you would never think of looking for them. There is just one place more where you really must stop awhile. It is so high up in the air that it would be nicer to go in a flying machine, although you could go in a railroad train from Venice. You can "play like" you are going in a flying machine. It's the easiest thing in the world to "play like" isn't it?

The finest place to start from is the open square in front of a fairy-tale palace, and the fairy-tale church of St. Mark's in Venice. They are all white marble arches and gold, and carved angels and flowers, and lovely spires that go away up to the clouds. Thousands of pigeons flutter about there, and nest in the hearts of the marble

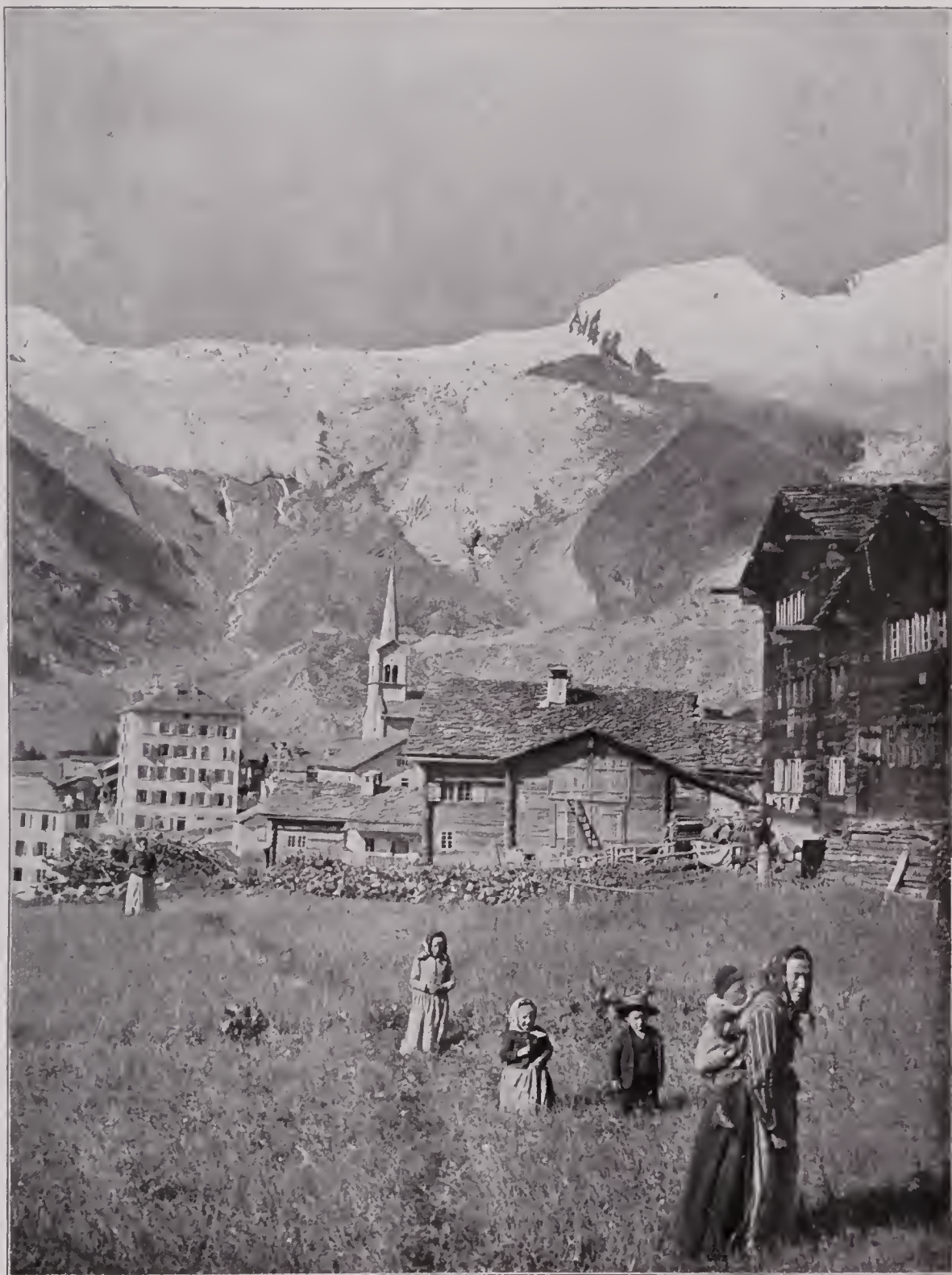
flowers, and between the wings of the angels. They will fly a little way up with you in the gold sunshine. But very soon you leave them below you. Then the spires are below, and even the blue sea drops away out of sight.

Do you know how high you are? Nearly three miles. The air is very thin and pure and clear. Away off to the north you can see piled up clouds, all pink and pearl and violet and gold—and diamonds! See how they flash all the colors of the rainbow in the sun! Why, it's ice and snow—mountains of them away up in the sky! The mountains are called the Alps. And you are above them, looking down. What do you see?

Jagged peaks of rocks and ice are crowded and tumbled together; steep slopes and broad fields of snow lie below them. High between the slopes are hundreds of streams and cascades of glittering ice. Those are the frozen rivers called glaciers. Below them, growing on snowy slopes, are forests of dark pine trees. Farther down are green valleys where cattle feed, and in the deepest pockets of the mountains are blue lakes like mirrors. Surely no one can live in a country that stands on end like the Alps! Oh, yes they can. This mountain country is Switzerland. It is only two hundred miles long and one hundred fifty wide. Two thirds of it is mountains. Some of the peaks are nearly three miles high. But more than three million of the busiest people in the world live in Switzerland. A third of them are farmers, too.

Now you know they must use every scrap of good earth that is as big as a table cloth. On every shelf of rock a stout little house, of stone and pine timbers, nestles. On every wide shelf there is a whole village, with a school house and a church. In the valleys are big cities. On every lake shore are hotels for travellers who come from all over the world just to look at this beautiful land. Nearly every one of these travellers ask their Swiss guides how all those towns and farm-houses came to be scattered over the mountains. And they ask why the Swiss people have no language of their own but speak German, French or Italian, and sometimes all three, as well as English. This is the story the guides tell.

“Once there was a very lazy goblin. He came from the Rhine River, in Germany. He wanted a city, but was too lazy to build one. So he picked up a lot of houses and put them in a bag. Then he went across the river into France and stole some more houses. In Italy he stole palaces and churches. He put all these in his bag



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SWISS MOTHER AND CHILDREN.

With village in which they live, and in the background the Alps mountain range, showing glacier and eternal snows.

and started over the Alps with them. There was a big hole in the bag, so every once in a while a house dropped out, until he lost everything he had stolen. Every house stopped where it was dropped because it couldn't get down again. The funny thing about it was that there were people in those houses, and they staid, too, because they liked the country. They couldn't agree on a King, so they agreed to do without one; and every man kept his own language and learned the others. By and by, so many English and American travellers visited the country, that the Swiss people learned English, too." The Swiss people always tell this story to their children.

The first time her big brother Vietor told her the Lazy Goblin story, little Marie Louise laughed. She loved her mountain home. From the air-ship you can see it down there on its shelf of rock. A stone wall with a grove of pine trees is behind and above it, to keep the mountain snow from falling on it. The roof slopes so far out beyond the walls, to let the snow slide off, that you cannot see its many little windows filled with blooming plants. But you can see Marie Louise outside, in her bright blue skirt, white blouse, and black velvet waist laaced tight to her plump little body.

Marie Louise feeds the chickens and waters the potato patch. She sits among the flower beds with her knitting and watches the honey bees filling the hives. She has bread and butter and honey, wild strawberries, goat's milk and cream cheese for her dinner. She eats from a wooden bowl that her father made. Vietor earved a wild strawberry vine around it. Vietor made her a spoon from the horn of a chamois (sham-my). A chamois is a very fleet little mountain antelope. Her winter coat is lined with warm chamois skin. On her spoon handle is earved a bunch of edelweiss. Edelweiss is a tiny white flower that grows high up on the banks of the frozen rivers. This is how Vietor got a bunch for a pattern.

He guided some travellers across the glaciers, and away up among the icy peaks. He took his iron-tipped staff, or alpenstock, to keep from slipping, and tied the travellers to loops in a long rope, one behind the other. When he brought them all down safely they gave him money. He showed Marie Louise how high, and in what dangerous places he had been, by the bunch of edelweiss in his hat.

In the summer Vietor is a guide. The father goes up the mountain with the cows, to where there is sweet grass. There he lives in a little dairy house and makes butter and cheese. In the winter time they are all together in the house. There is a big porcelain

stove, as white and shining as a bath tub, to keep the house warm. The mother knits and makes embroidery to sell. The men carve wood to sell to travellers the next summer. They make bowls and cups and boxes and napkin rings, and clock cases carved with edelweiss and alpine roses and chamois heads, and with spires like the peaks of the Alps.

The children go to school in the village below. It is a mile away, but they get there in about two minutes. They *slide* down, on sleds. That is fun. But, oh dear, they have to climb back, after school! Once, when it was snowing hard, Marie Louise and some little playmates lost their way, and they got so cold and tired they fell down and went to sleep in the snow. Who do you think found them and brought their fathers to carry them home?

Big, white and tan, Saint Bernard dogs! The dogs live with some good, religious Brothers away up on the mountains, and they go out to find lost people. The dogs were so glad to find the children that they barked and called everybody for a mile around. They stood there by the snow-covered children until men came. The Swiss children love the big dogs.

Victor held Marie Louise on his lap that night, as if he would never let his little sister go, again. While she snuggled there, he finished a clock case. In it he made a tiny room with a spring-door. When it is time for the clock to strike, this door flies open in the most surprising way, and a little bird hops out and says:

"Cuckoo! Cuckoo! Cuckoo!"

Dear, dear, so late as that? It's time you were hurrying home to America. See *Red Sea, Suez Canal, Mediterranean Sea, Greece, Athens, Turkey, Constantinople, Italy, Venice, Byzantine Art, Greek Art, Italian Art*, in article on FINE ARTS, *Greek and Roman Literature*, in article on LITERATURE, SWITZERLAND, ALPS MOUNTAINS.

XIX. THE "FRONT DOOR" OF AMERICA

The very nicest time to get home to America is on a summer morning. You have been on the water nearly a week. You have crossed the same Atlantic ocean, that the white children and the black child crossed, so long ago, to find new homes. As you lie half awake in the bed that is built in the wall of your tiny cabin, some one on deck cries "Land!"

You jump out of bed, scramble into your clothes, and run to the upper deck. All the first cabin passengers are there, leaning on the rail. Far off you see, low down on the water, what looks like a bank of blue cloud. Some are looking at it through opera glasses. The sun strikes across the water. The thin morning fog flies away. Now you see green grass and trees, on the cloud bank. On the other side of a narrow strip of water is a long, sandy point with a lighthouse on it. A cheer goes up. Handkerchiefs are waved. Everybody is glad to get home. Slowly the big steamer moves through the narrow strait. All at once you are in the wide harbor of New York. This is The front door of America. Near the entrance to the harbor, on an island park, is a great statue of Liberty, holding a torch in the air.

What a different scene this is from what the Dutch children found here, three hundred years ago. Then this harbor was a wilderness of wooded shores, with only a few Indian canoes on the waters. Now, the long narrow island in the mouth of the Hudson river, and the shores around the harbor, are covered with high buildings, as far as you can see. The waters are arched with bridges, and crowded with ships.

If all this looks strange to you, think what it must look like to poor foreign people who came to America to find new homes. New ones come almost every day. You didn't know there were thousands of them on your ship, did you? A great ocean steamer is five or six stories deep, you remember. You have lived in the top story, or first cabin. You have never seen the people below you. You can see them now, as they go ashore over the gang plank, if you stand by the deck rail and look down.

A crowd of the strangest looking people pour over the gang plank from the third deck, or steerage. They look like little bits

of all the countries you have seen or read about. Few of the women wear hats. They have handkerchiefs or caps or shawls on their heads. They carry babies in their arms, on their hips or their backs. Little children cling to their short, wide skirts. The men and boys carry mountains of queer shaped bundles and boxes and bags, on their heads and shoulders. They stand by these bundles on the dock, as if they feared to lose them. Men in uniform keep the crowds moving. They shout orders in a dozen languages. The people are weary from the long journey, but oh, so interested in everything, so eager and hopeful. They wait patiently with their babies and their bundles, and do everything they are told to do.

They will not be allowed to leave this dock, as do the cabin passengers. Although they are on American soil they have not been admitted to make their homes here, yet. In the old days, every one could come in freely. They cannot do that now. We found that a great many very old people, and orphan children, and blind and crippled and feeble-minded people, came. They did not belong here, but we had to take care of them. Many bad men came, too. They had been in prison in their own land, and they gave us much trouble. So laws were passed to admit only those who were strong and well, and good honest workers. Every one who comes must have some money to give him a start. Children and old people must have some one to care for them.

All these people must get on a barge, or open boat, and go back to the emigrant station on Ellis Island. Ellis Island is just inside the harbor. You can buy a ticket and go there to see these people examined and questioned by government officers. Your boat is fast so it passes the barge.

When you leave your boat, hurry across the open space to a big building like a railway station. Go up a side stairway to a gallery that runs around a big, white-tiled room and look down. Up the wide, central stairway come the people from the barge. There are thousands of them. See if there are any you know.

Oh, there are the Dutch children. They wear wooden shoes just as they did three hundred years ago. That is an Irish family. The children have merry eyes. That is a German family. The children are stout and fair and rosy. You wonder if "dear mother" has a Christmas tree in that beautiful linen chest she sits on. There are some English or Scotch people. The little girls are shy, the boys

GATE OF OUR PROMISED LAND



HERE IS THE GREAT BARTHOLDI STATUE AT THE ENTRANCE TO NEW YORK HARBOR AT SIGHT OF WHICH THE IMMIGRANT AND THE AMERICAN RETURNING FROM FOREIGN SHORES, SHED TEARS OF JOY.



A newly arrived German immigrant with his eight children and their "liebe mutter."



Here is the immigrant station on Ellis Island where all foreigners are examined to see if there is any objection to their entering the United States.

independent little fellows. And there are such a lot of people who never came to America at all, in the old days.

Those big, black-bearded men in long overcoats, caps and high boots are Russian farmers. They will go out to wide western plains to grow wheat. We need that kind of Americans. The smaller, long-bearded men who are near them, are Russian Jews. They have had trouble about their religion, and come to us for peace and safety. They will work in tailor shops in the big cities. Some will be peddlers. By and by they will have good shops of their own.

Those men in velvet jackets with nickel buttons and bright red vests, are Hungarians in their Sunday clothes. Some are in sheepskin coats. Their women have short skirts, bare heads and embroidered aprons. These people will work in mines and packing houses and steel foundries. There are no women with those red-capped Turks who have come to sell us Oriental rugs. Those handsome Greeks will be peddlers of fruit or of plaster casts of old Greek statues. The Italians, with dark, rosy faces, have dozens of little ones with them. The men are small, but they can do the hardest kind of labor on railroad beds and street sewers. The Norwegians are tall. In their old home they are sailors. They will not be afraid to do iron work on sky-scrapers and bridges. Those fair, very clean young women are Swedes. With the German and Irish girls they make the best housemaids in the world. There are very few people among these newcomers who cannot do some useful work.

Men in uniform are at every door and stair landing. They can speak many languages and they know what country every one comes from by his dress and face. They are kind to these strangers. Now, one says to a scared little Italian woman, in her own language:

"Signor-a (madam), come in out of the draft. The bambino (baby) will catch cold." She smiles happily to hear her own dear tongue in this strange America. So it goes, all along the line. Five thousand strangers are made to feel at home.

On one stair landing stands a government doctor in uniform. He looks closely at every man, woman and child. Now he pulls a man out of line and marks a cross on his sleeve with chalk. The doctor thinks this man has tuberculosis. That is a "catching" disease, and few people get well of it. He must go to a special room and be examined. Another doctor looks at people's eyes. Another looks at their faces to see if they are bright enough to earn a living. People who are a little sick from the journey are sent to a

hospital, right on the Island, and made well. Children with measles or other "catching" disease that they can be cured of, are sent to city hospitals.

Inspectors look at the numbered tag pinned to each emigrant's coat, and tell him which wire-screened room to go to. There he finds an officer who speaks his language. The officer has a long paper that tells all about him. It was filled out in the seaport town from which he sailed. Now he must answer all these questions again. What is his name, his age, his birthplace? What useful work can he do? How much money did he bring with him? Has he friends in America? Where does he want to go? Has he ever been in prison; or in an asylum; or dependent on charity? What is his health? If his answers are satisfactory and truthful he pays a fee of \$4.00. This is to pay the expenses of the emigrant station.

Then, if he is going farther than New York, an officer goes with him to the ticket office. He buys his ticket and checks his baggage. He finds that, in America, people do not drag heavy bundles about with them, but have them carried safely in trains, for nothing. Then he is put onto a barge with other people going his way, and taken to his railway station. There, another agent puts him on the right train. He is not allowed to go wrong. No one can cheat him or get his money away from him. Many have to wait until friends claim them, or until the sick members of the family come from a hospital. Such people have a big, steam-heated room to sit in. They have good food at low cost. They have white iron and canvas beds to sleep in.

Every one who is admitted to America leaves the emigrant station through a certain swing door. A smiling man in uniform stands there, looks at the admission ticket and points the way. On the door is a sign that reads:

'Push: to New York.'

That is the front door to America.

Once the new-comer is through that door he can go anywhere he likes, in our broad land, to live and work. Some days five thousand emigrants go through that door, and every year a million or more. In a few years they learn to speak English, and all other American ways. Their children go to our schools. They all change into Americans so quickly you think there must be some magic in the words on the front door:

"Push: to New York." See NEW YORK CITY, RUSSIA, HUNGARY, SWEDEN and NORWAY.



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AIR AND LAND TRANSPORTATION

- 1—Dirigible Balloon. 2—Aeroplane. 3—Eskimo Dog Team. 4—Prairie Schooner. 5—Russian Troika
 6—Reindeer Sledge. 7—Camel: Ship of the Desert. 8—First Railway Train in England, 1825.
 9—Modern Railway Train. 10—Automobile.



MODES OF TRAVEL IN DIFFERENT COUNTRIES

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- 11--Jinrickisha, Japan. 12--Llamas of Peru. 13--Palanquin, China. 14--Tagalog Tandem, Philippines. 15--English Coach. 16--Sicilian Cart. 17--Spanish Milkman. 18--Cart with Bamboo Cover, Borneo. 19--Elephant with Howdah, (canopied seat) Siam.

WONDERS OF THE WORLD WE LIVE ON

EDITORS' NOTE TO MOTHER AND TEACHER.—When the writer was a child, Physical Geography was a high school study. A hard name often makes a simple thing difficult. Physical Geography is only land, water and air, and their effects upon each other. It is Home Geography to every child, no matter where he lives, and within his every day experience. Before he goes to school at all, he has made sand houses and mud pies. He has paddled in ponds, picked up pebbles and shells, slid on the ice, thrown snow balls, and sent up toy balloons and sailed boats and kites. Just by using his little hands and feet and eyes, in play, he has learned more about Physical Geography than most grown people realize, and he has put his knowledge to good use. The wisest teaching of today builds upon the knowledge and interests already possessed. It follows nature's plan, too, of continuing to use the objects nearest at hand.

Home Geography, then, is the very first and most fundamental of all nature studies. Loam, sand, gravel, clay, boulders, quarry stone, coal and mineral rocks, can be brought into the house and school room. Out of these, with intelligent direction, little children can build up a miniature world that they can understand. With every natural child knowledge is power. He wants to use what he knows, to "make things." On a common kitchen table, with an upright strip nailed about the edges, he can make a landscape. A child who piles up a tiny hill, levels a field, scoops out a bowl and a trough, and fills them with water himself, can make his own definitions. From these clear mental images, he can be led to imagine the big round world of mountains, plains, rivers, lakes and oceans.

It is very wonderful how quickly a child catches an idea. In his play, he reproduces big things on a small scale. He can make a satisfactory rain with a watering pot, so he will understand the vapor cloud made by a boiling tea-kettle. Most, if not all, of the properties of earth, air and water, can be made plain to a child by just such simple means always near at hand. Air is really no more difficult than the other two. The child already knows temperature, and wind, or air in motion. The little hot-air balloon and the flying bird are among his earliest objects of wonder. The fact that air cannot be seen or felt, only adds to its interest to a child who believes in fairies.

As you read these nature studies in Home Geography, and try the experiments suggested, in doors and out, with the children, watch their minds expand, with new and interesting ideas, and open like flowers. The most important part of education is to get a child to see things accurately, and with such keen interest that he bubbles over to express himself in word, form or line.

WONDERS OF THE WORLD WE LIVE ON

I. LAND

When you went around the world you found that this earth we live upon is made of just land and water. But what a number of things were made with them. No two countries looked just the same, but they were all beautiful and interesting. Do you want to know how they came to be so different?

You need not go around the world again to find out, but it will help you to understand everything better if you will remember what you saw—the grassy plains, the high, rocky mountains, the green river valleys, the sandy desert. No matter where you live on the earth, there is land and water. In any wood or field or city park you can find out a great many of old mother earth's secrets.

This is a perfectly flat meadow, isn't it? It is covered with grass and flowers. Here is a pond, with water-flags and cat-tails and pussy willows growing about it. The water is as still as if it lay in a wash basin. No, there is a ripple on the other side. A little stream, almost buried in grass, is flowing in there. The water runs very slowly. The land on that side slopes a little toward the pond, or the tiny stream could not flow into it. Water never runs any way except down hill. Here is another little feeder to the pond, and another! Here the water runs out of the pond, through a larger brook. The meadow isn't flat at all. It is made up of little slopes. The pond is a small lake. Some lakes are hundreds of miles long, but they were formed just like this pond. The water from them flows out through a big river, instead of through a little brook. They are fed by many small rivers, and by springs underneath, too.

Wherever a pond or a lake is made on land, there must be a low place shaped like a bowl, with the land sloping down on all the sides but one. But sometimes, for hundreds of miles, the land slopes from only two sides, making a trough between. There you would find, not a lake, but a river. When the river is very long and deep, like the Mississippi, its valley is hundreds of miles wide. The slopes rise slowly, but they rise high, to the very tops of mountain ranges. Many big streams run down these long slopes to feed the main river,

THE STORY TOLD IN THE ROCKS



The story of the earth is long. It is found recorded in the rocks. These pictures tell a part of it. You see a stream which ages ago flowed down through the mountains to the sea. Its rushing current carried sand, gravel and stones which fell to the bottom of the sea and covered up shells, bones of fish, etc., which lay on the bottom.

Later great monsters lived in the sea; some of these are shown here. The large one lifting its head above the water had a long name which means "fish lizard." As time passed the stream grew broader and washed down more stones and soil which fell into the sea, covering the sea weeds, shells, bones of dead fish, etc.

The great fish lizard was killed in a fight with other monsters, and its body fell to the bottom. Trees now grew on the land and dead trunks and branches fell into the sea, became water-soaked and dropped to the bottom. All these were covered up by material which was carried down by the stream, now become a great river.

CHANGES IN THE EARTH THROUGH LONG AGES



At length great animals appeared on the land. One of these died on the river's edge; its body was caught in the swollen current and carried to the sea bottom. Here it was soon buried under the shower of soil and gravel which the river kept pouring into the sea. Each layer of this material, sand, gravel and remains of animals spread on the sea bottom hardened into rock under pressure from above.

After long ages men began to live on the earth. They lived in a very crude way. They had clumsy boats made from hollow tree trunks, bows and arrows and stone hatchets. One day a man dropped his stone hatchet from his boat and it fell to the sea bottom and was buried in the mud.

The ocean bed was thus built up toward the surface, and finally became dry land. Men dug deep into the earth, and in the rocks found marks of these buried objects; the stone hatchet, the animal and vegetable remains, shells, bones of fishes, etc., in descending layers of rock, and thus read the story as we have it here.

and little streams feed the feeders. If you made a map of the Mississippi river and all its feeders, it would look like an oak tree with no leaves on it.

Don't you want to follow a brook that flows into a river, and find out where it came from? It's a long walk, and up hill all the way. Make up a bouquet of flowers as you go. If you had a boat you could get some water lilies here, or with rubber boots for wading, some purple water flags. There are some pussy willows. How thick and green things grow, on the low river bank. And how soft and black the soil is. Where it is a little higher and dryer, you can pick ferns and buttercups. Higher still, in the maple woods along the brook, you may find violets. On that high, gravelly bank are tall, weedy looking plants. In the fall, if you come here again, you will find golden-rod and purple asters. The brook is getting narrower and shallower, but it runs faster. There it is almost hidden by hazel brush. See that squirrel? He knows there will be nuts here, and acorns in that oak tree he is running up. The brook is only a thread of water, now, but running very fast between banks of scanty grass. There is some ground pine and pink laurel, and dry gray lichens on the rocks, among scattered pine trees.

Why there is a bunch of ferns and a cushion of velvet moss! Part the ferns with your fingers, and find sparkling water gushing out of a little nest of wet rocks. This is a spring. It is the birth place of the brook. These are the only ferns you found up so high. Ferns love water and soft soil. The spring gives them the food they want.

It seems perfectly flat here. You can look over a high, wide country. Here is another spring. But the brook it makes flows the other way! Then, of course, the land must slope the other way, too. We are on a ridge of land, or divide. Sometimes a divide is called a watershed. It is like the roof of a house. The water flows down each side of a roof to the water troughs under the eaves. The rain washes the roof clean, doesn't



Pieces of rock broken from a cliff by rains, frost, etc., and dropped into a river.

it? Well, the little streams wash the land slopes clean. First, they soften the ground they flow over and make mud. The mud mixes

with the water and goes along with it. Stones are loosened and rolled along, too. Fill a big gold-fish bowl with this muddy water at the mouth of the brook, and let it stand awhile to settle.

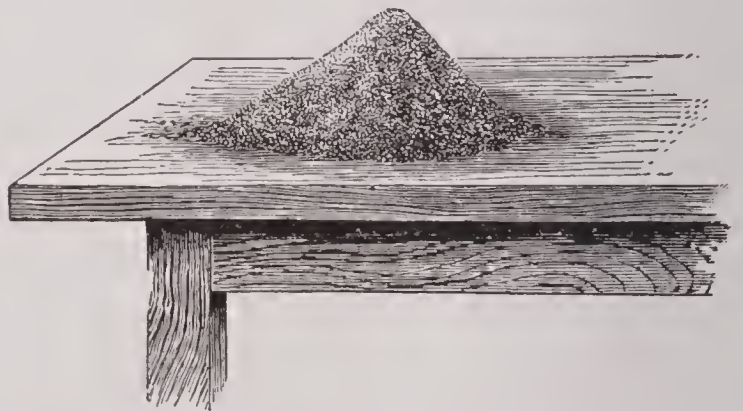
Through the glass you see clear water at the top, then mud, then sand, then gravel. The gravel falls the lowest because it is



Stones from same cliff after they have been worn and rounded by rolling about in the current of the river.

the heaviest. The little brooks rob the hill sides of the soil that plants need, as well as of the water. They melt and break up this soil as fine as they can. They even take some sharp corners from the pebbles by rolling them over and over in the water. Running

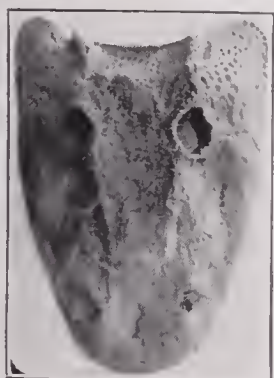
water is a busy miller. It grinds earth to mud, and rocks to sand. Then, when it gets down to low ground, where it flows more slowly, it drops all this heavy matter along the river banks, in the river bed, and far out into the ocean. The gravel drops first, then the sand, then the mud. If you dig a well in the valley you will find a layer of loam on top, then sand, then gravel, on a bed of stiff clay or rock. If you scoop out a river bed you find things in the same order. In the ocean you find the gravel near the shore. It hurts your bare feet when you go in bathing. The sand is farther out, and the mud farthest of all. The water sorts all this earthy matter and puts each kind by itself. Isn't that wonderful? The top layer of loam is a mixture of clay and sand and leaf mold. Leaf mold is added every season by falling leaves and decaying seeds and roots. It makes the soil softer and richer.



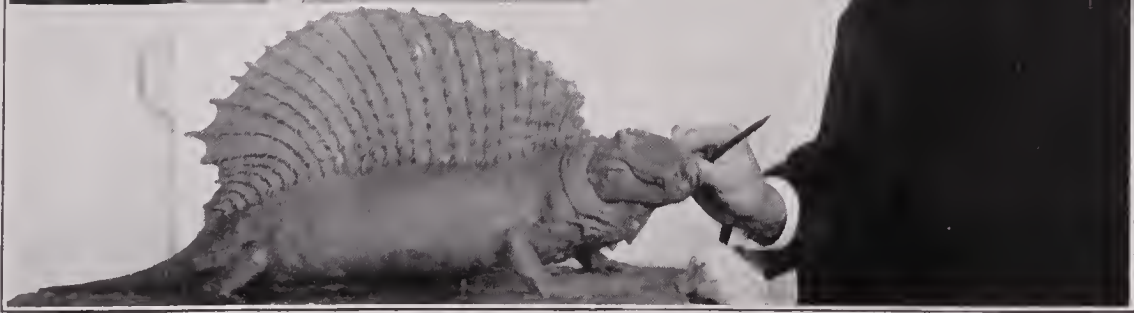
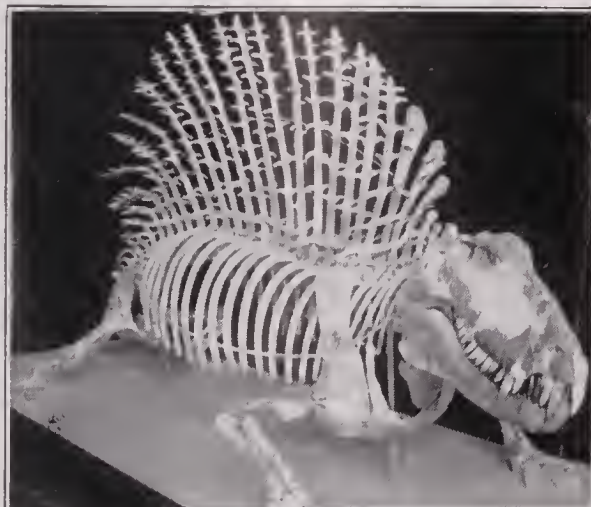
A heap of sand consisting of particles worn from the stones and gravel in the river bed.

This water miller has several stout helpers in wearing down land. One is wind. Wind picks up dust and scatters it. Then it is more easily washed into the streams by rain. Frost is a regular little wedge and hammer. When water freezes in a crack in a rock it swells, or expands, and splits the rock into pieces. The roots of all plants and trees split the soil, too.

THREE MONSTERS OF OTHER DAYS



Skull of an Eypops, chief prey of the Naosaurus.



That "hairy elephant" is a mastodon. His bones were found in New York. He measured 14 ft. 11 in. from the base of tusks to tail. The artist is modeling the Naosaurus or fin-backed lizard, whose skeleton was found in Texas. The Naosaurus was 9 ft. long and 5 ft. high.

Burrowing animals like muskrats, foxes and snakes make little caves that often fall in. Earth worms and beetles honeycomb the ground with tiny tunnels. Finally men loosen the soil by plowing and building. All these things make it easier for the little water miller to wash down the good top soil.

On high mountains, nothing but bare rocks are left behind, and rain, wind and frost work all the time to wear them down. The water scours the river beds deeper, and carries as much earth as it can out into the ocean. What becomes of the good soil that is washed into the ocean? It has been ground to powder or melted to paste.

Water is very heavy. A little boy or girl cannot carry a wooden pail full of it very far. Every pint of water weighs a pound. The ocean is deep. There are hills and valleys and mountain ranges on the ocean floor, just as there are on land. Some places are as deep as our mountains are high. Tons and tons of water lie over every foot of the ocean floor, and press it smooth and hard. The under layers turn to stone. All the earthy material was sorted, so now it turns to many kinds of stone—sandstone, shale rock and slate. Far out, in the deepest part of the ocean, where sand and mud are never carried, the ocean bed is made of fish bones and shells. These are ground to white powder, by the weight of the water, and turned into chalk or limestone or white marble.

You know what a volcano is, don't you? It is a mountain with a fire in it. That fire comes from the middle of the earth. It lies far under all the land and sea. Sometimes this fire breaks through a mountain top, and it breaks through the floor of the ocean, too. When it does this sandstone is melted, and when it hardens again it becomes granite or lava rock.

There are quarries of all these stones and marbles on the land. If they were made in the bottom of the sea how did they get up on the land? They were pushed up by the fire. The fire melted and cracked and pushed, until the rocky floor of the ocean came up through the water to form rocky islands. A long string of these islands slowly became a mountain chain. In pushing up, the rock



A piece of rock showing the remains of little sea animals which are contained in the rock.

layers were broken and folded in many curious ways. In valleys the rock layers rose more evenly. Just as soon as a point of rock rose above the water, rain and wind and frost and, after awhile, plants and animals began to wear it down. Slowly the valleys between the mountains were raised and filled with finely ground rock waste and leaf mold. The water from above gathered into lake bowls and river troughs.

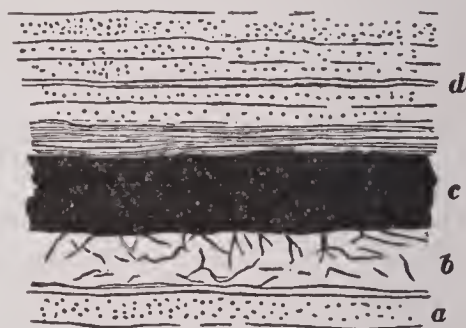


A glass of water taken from the muddy river, to show how the fine particles worn from the stones, settle down on the bottom as a layer of mud.

You see the story of land goes around a circle. Mother earth is all the time tearing down and building up. She doesn't mind spending millions of years in grinding a mountain into mud and sand; pressing these into stone, and lifting the rock layers into mountain chains again. While she is about it, too, she puts gold, silver and copper, iron, lead and tin, salt, sulphur and coal, and many other things, into all the cracks and holes, and between the layers of stone. She hides diamonds and many precious jewels, too. It would take too long to tell here how she does all these things. It took men thousands and thousands of years to find the keys to unlock the prisons of all these useful and beautiful things.

You really ought to know about coal. It was made by pressure under sea water, like stones. But what do you think it was made of? What do you look for to make a fire? Wood! Rocks may melt, but they harden again. Only plants will burn to ashes.

Ages and ages ago, simple plants like moss, with woody stems and no leaves, grew on big, quiet ponds until they covered the water. The moss died below, but did not decay, and it went on growing on top, until a spongy, floating mat many feet thick was formed. There are many such beds of moss today. They make a spongy brown fuel called peat. Peat is burned in Ireland and other countries. Peat would become coal, after a long time, if it sank below the sea, mud and sand or shells settled on it, and the sea water pressed it between layers of rock.



This picture shows a vein or bed of coal as it lies in the earth, with layers of different kinds of rock above and below it.



PAINTED BY THOMAS MORAN, A. N. A.

THE SENTINEL

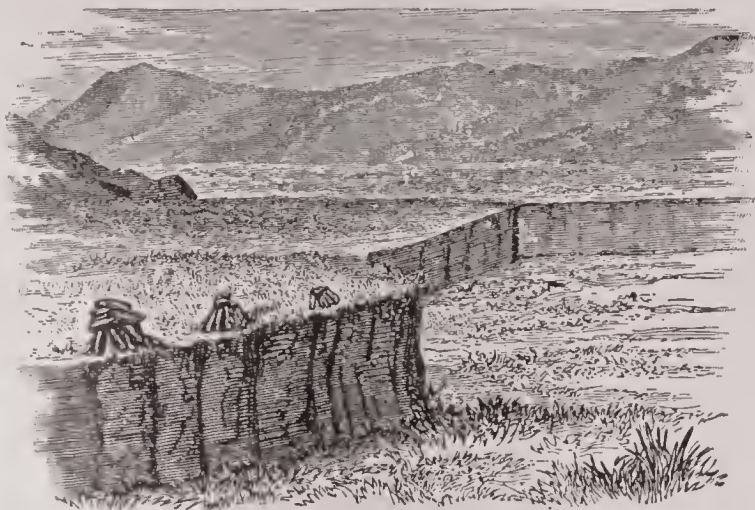
"The Sentinel" is one of the wonderful things that Alice saw. Two of Mr. Moran's paintings were purchased by Congress for the Capitol.

Every part of this earth story is going on today. Volcanoes still burn, earthquakes still lift and crack and fold the rocky floor of the ocean. You remember the terrible earthquakes we have had. They shook down great cities. The earth under them was

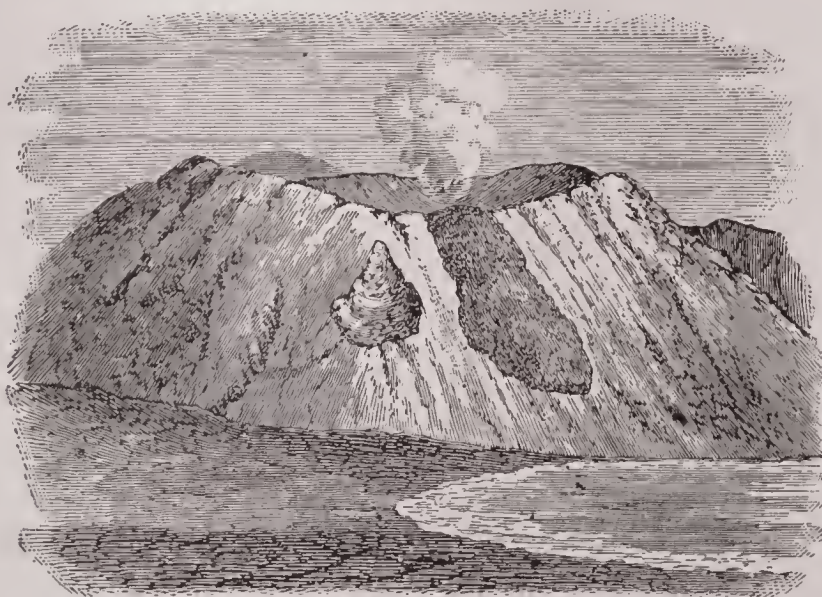
lifted a little, or dropped a little. One volcano poured out melted rock, or lava and granite, and buried a city. Some seacoasts are slowly sinking, some rising. Small islands come up or disappear. The valleys are being filled up, the mountains worn down by water, wind, frost, men, animals and plants. Tons and tons

of mud and sand are being carried out to the ocean every day, to be turned into stone again. Sea animals are dying, and dropping their bones and shells to the ocean floor.

Isn't it a wonderful story? Don't all these things mean a great deal more to you than they did before? See GEOLOGY.



A bed of peat, showing where it has been cut out and used for fuel; also small stacks of peat piled up to dry.



This picture shows a volcano in action. The hollow top is the crater from which rocks and lava have been thrown out, and a stream of lava is flowing down the side.

II. WATER

The other thing this round world is made of is water. In going around the earth you crossed oceans, lakes and rivers. You saw ice or frozen water. You saw water broken up into rain drops, frozen into hailstones or snow. But there was a great deal of water everywhere that you did not see at all, or if you saw it you didn't know it was water.

The story of water is just as interesting and wonderful as the story of land. Where shall we begin to find out about it? Let us begin with one day when you were a small boy playing out of doors. Mama called you.

"Run in, Johnny, it's going to rain!"

"Why is it going to rain?" you asked. Bright little boys and girls are big question marks, running around on two stout legs. They want to know the "why" of everything. Nearly all of their "whys" are very sensible, too, and ought to be answered.

See that dark cloud rolling up the sky. That cloud is as wet as a soaked sponge. The wind is blowing it up. The wind is colder than the air was a few moments ago. Now the little drops come pattering down. They are as round as shot from whirling so far down from the sky. The sun is out again. The rain has stopped. The dark cloud is gone. Where did it go? It fell to the earth in rain drops. But how did the rain cloud get up in the sky? What is a cloud?

You can make a very small cloud if it is a cold day. Go to the door and breathe into the frosty air. You can see your breath, can't you? Not all of it, just the water in your breath. The water is broken up into very fine mist, or vapor. Vapor is a kind of water dust. The air soaks up vapor as a sponge soaks up water. There is a beautiful little vapor cloud coming from the teakettle. The air soaks that up too. A wash boiler full of boiling clothes makes a big cloud that fills the kitchen. If you open a window or door it will all go out and be soaked up by the air.

If a cloud of vapor is made in a house and cannot get out, let us see what happens. The vapor from boiling water is very warm. The glass window is colder. The vapor gathers on the glass in a mist of tiny drops. The little drops roll together into big drops.



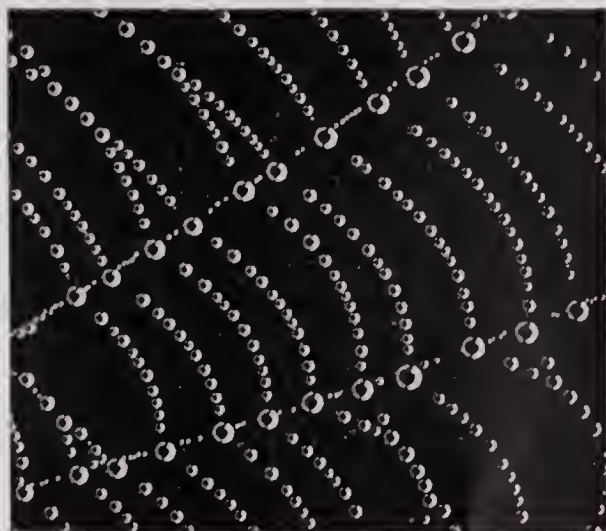
CUMULUS, A LIGHTLY FLOATING FAIR WEATHER CLOUD.



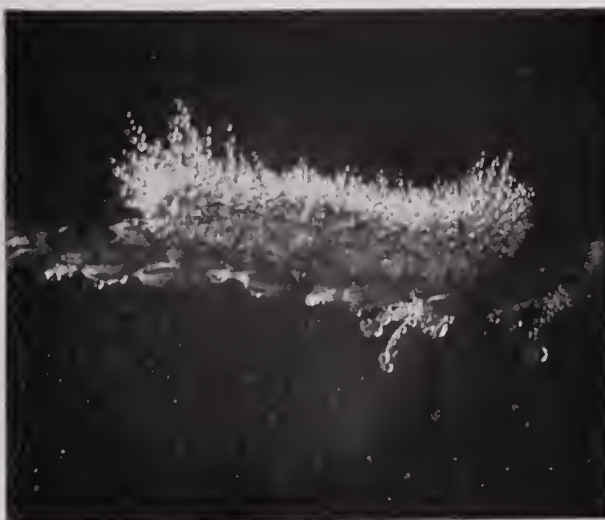
THUNDER SHOWER CLOUD.



DEW-LADEN FLOWER AND BUDS OF THISTLE.



SECTION OF DEW-LADEN SPIDER'S WEB.



SLEEPING CATERPILLAR DECORATED WITH DEW-DROPS.



DEW-LADEN GRASSHOPPER ASLEEP ON BED OF FLOWERS.

The wonderfully beautiful photographs of dew and frost and also of snow crystals which we present, were furnished for this volume by Mr. Wilson A. Bentley, who is recognized as the pioneer in microphotography, and who has been employed by the government in this work for many years.



HOAR FROST ON BLACKBERRY LEAF.



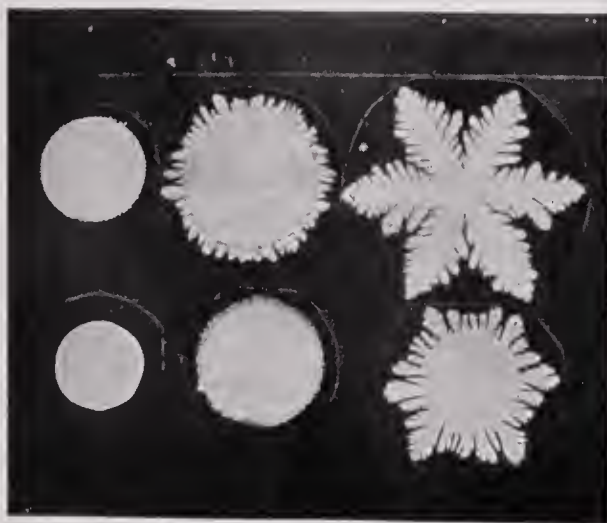
HOAR FROST ON GRASS BLADE



FEATHER-FERN FROSTWORK ON WINDOW.



SCROLL FROSTWORK ON WINDOW.



DEVELOPMENT OF ICE CRYSTAL FROM SMALL ROUND TO LACE-LIKE FORM.



CORAL-LIKE BRANCH SHOWING FEATHER TYPE IN DETAIL.

These get so heavy that they roll down the glass. They roll down the walls, too, and drop from the ceiling. If vapor is not turned out of doors it makes a room damp. That is just what happens when it rains. The vapor in the air goes up into the sky. When it finds a cold layer of air it rolls into large drops and falls.

Vapor is always going up. Most of it goes up from the ocean, the lakes and rivers. Three fourths of our big world is covered with water, you know. The sun warms the top layer of water and turns it into vapor. Every leaf and blade of grass on the land has water in it. The sun steals this water, too. Sometimes it takes so much and gives so little back again that the grass turns brown, and the leaves wilt. Every animal and plant drinks water and breathes it out again from the lungs, or gives it to the air through little holes in the skin called pores. You know how you perspire on a hot day? Little beads of water ooze out, all over you. You can find your pores with a mag-ni-fy-ing glass. You can find pores in green leaves, too.

Plants and animals perspire more on a hot day than on a cold one. The land and water give off more vapor in the summer than in the winter. Wring a handkerchief out of hot water, hang it in the sun and see how quickly it dries. Set a shallow pan of water in the sun and see how soon the water disappears. The air is always thirsty. It drinks like a greedy fish.

But then, it is not stingy. It gives back every bit of water it gets. But it does not always give it back where it got it. Sometimes it rises in vapor from the ocean, goes up in the sky to a layer of cold air, and falls back into the ocean almost as quick as you can say Jack Robinson. But it's a very good thing for little boys and girls and trees and bees, that all the vapor doesn't do that. The ocean doesn't need the water rightaway, and the land does. A great deal of vapor goes on long journeys. It uses the wind for horses. Haven't you seen fleecy clouds floating across the sky? They were riding on the wind. The winds find it no trouble at all to carry these vapor clouds along with them. The vapor clouds travel until they strike a cold layer of air. Then they roll into rain drops and fall.

As oceans are the great vapor tanks, so mountains are the chief rain makers. The tops of mountains are very cold, and they are so high up in the air that the vapor clouds bump right into them and turn to rain. In the winter the air is so cold that the rain, in falling, freezes into snow. Wide river valleys, islands and sea coasts, get a great deal of rain and snow, too, if the winds blow over them

from the ocean. If the wind blows away from the land, so that it gets no rain, that land becomes a desert.

Just as the ocean is a great tank for making vapor, so the mountains and woods and cold countries are big storage houses for snow; much of the summer rain is lost. It runs off at once into streams, or is soon taken up again by the sun, in vapor. But snow lies for months, in cold, high, or shaded places. In the spring it melts slowly and soaks into the fields. It takes snow a long time to get into rivers. It gives plants and seeds water just when they need it, to help them grow. A farmer can get along in a dry summer, if there has been a wet winter.

In the story about land you saw what a big part water plays in this world of ours. Every drop of rain that falls takes up just as much dust as it can carry on its tiny round back, and hurries away with it. It washes the dust and smoke and bad smells out of the air, and leaves it pure and clean. It washes the dust from all plants and makes them bright. It would give you a merry shower bath if you stood in it. It washes the houses and the streets. You can see muddy water running down the gutters. How clean everything is, even the pebbles in the road, after a bright, hard rain. Mother Earth has had her face washed, and she looks as if she liked it!

Sometimes vapor clouds cannot get above the earth. You know the steam from the boiling clothes could not get out of the kitchen until you opened a window at the top. If the air lies very heavy above it and does not open a place for vapor to go up, it lies on the earth. Such low clouds are called fogs. You remember the kitchen walls dripped with vapor, making the room damp? Thick fogs make people and plants almost as wet as rain. Fogs are oftenest seen over the ocean, lakes, river valleys and swamp land. Sometimes they cover miles of sea, and shut in ships with milky white curtains of vapor. Then the ships must blow fog horns to keep other ships from running into them. The morning sun pulls a fog up into the sky, or a brisk wind scatters it through the air.

There is always some vapor in the air near the earth, even if there isn't enough for you to see it. If a pitcher of cold water stands in a room a little while, beads of vapor form on the outside, just as they did on the cold window pane. Sometimes the earth is cold enough to collect vapor beads from the air. When a cool night follows a hot day, the earth becomes colder than the air above it. So the warm vapor collects on cold plants, and spangles them with dew



BEAUTIFUL HIGH ALTITUDE CRYSTAL.



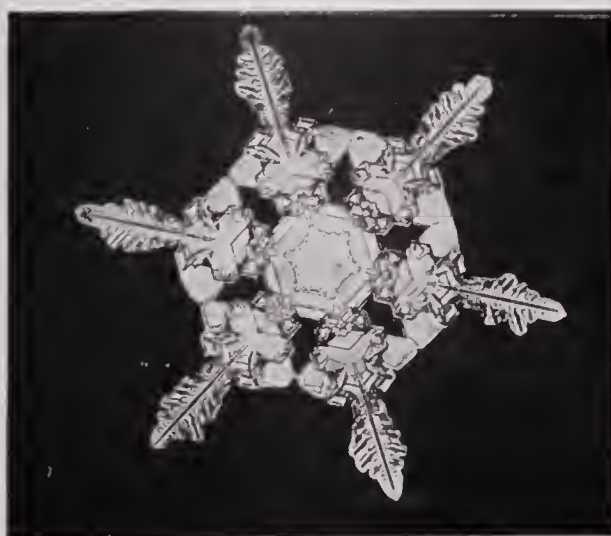
JEWELLED CENTER.



A BEAUTIFULLY ETCHED CRYSTAL.



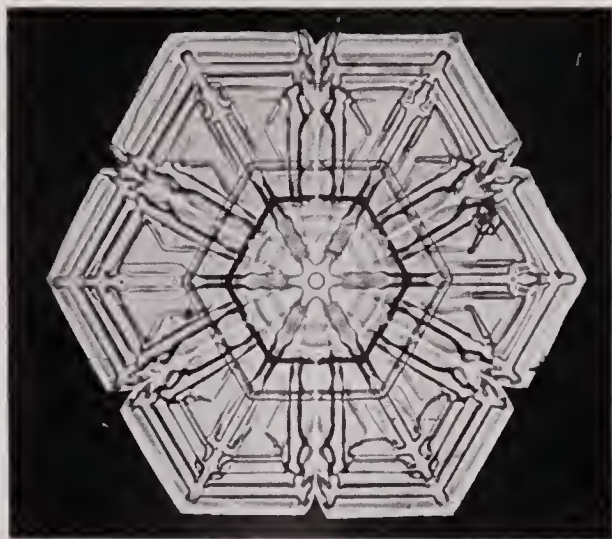
FEATHERY LOCAL STORM TYPE.



LOW ALTITUDE TYPE.



HIGH AND LOW ALTITUDE COMBINED.



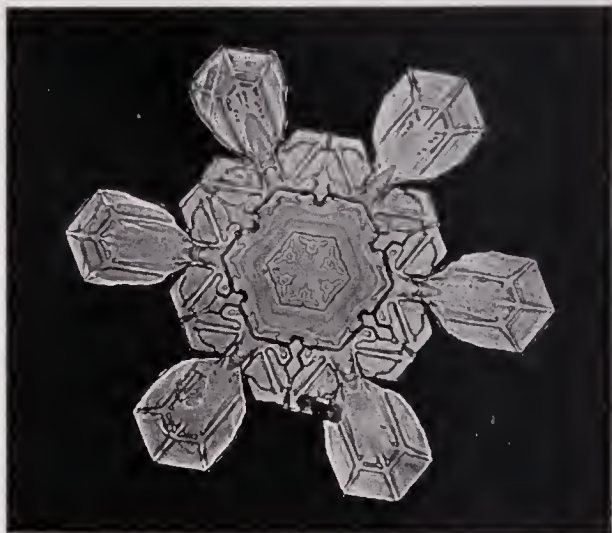
A RARE BEAUTIFULLY ETCHED CRYSTAL



ELABORATELY ETCHED DESIGN.



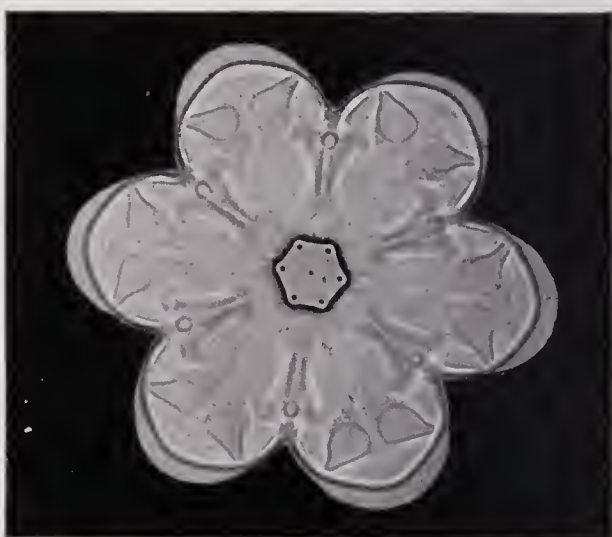
BEAUTIFUL STAR-SHAPED DESIGN.



PRISM-LIKE CRYSTAL FROM HIGH ALTITUDE.



COLD HIGH ALTITUDE.



SOLID HIGH ALTITUDE CRYSTAL.

drops. If the night is very cold when dew forms, the little dew-drops are frozen on the plants. Then we have Jack Frost.

Jack Frost is busy with you, too. He takes the vapor of your breath and per-spi-ra-tion, as you lie warm in bed, and makes pictures with it on the cold window pane. Such pretty pictures! They are all mosses and ferns and grass spears, and spangles to trim fairy queen's dresses.

Cold is a wonderful artist with water. It makes snow crystals and hailstone pearls. Snow is made by rain drops falling through air that is at the freezing point. The drops burst, when they freeze. Now, when things burst they make noises. You know how it is when fire crackers ex-plode? And pop-corn? If you were away up in the clouds, when it was snowing, and you had the ears of a fairy, no doubt you could hear the tiny rain drops explode into snow.

The Indians called pop-corn the corn that flowers. So snow is rain that blossoms. The next time you see a quiet snow storm, when the snow falls in large soft flakes, ask your mother for a piece of black velvet or cloth. Put it out of doors to get cold, but keep it dry. Then catch some snow flakes on it and study them through your pocket microscope. Most of them will look like little broken feathers. But if you are patient, you will be sure to find some that are perfect, six-pointed stars. The points will be veined and fringed like the petals of a flower. All snow flakes should be six sided or pointed crystals. Most of them are torn by the wind, or get their points knocked off by falling against other flakes.

Hailstones are made in quite a different way from snow flakes. Snow falls only in the winter, but hail storms come in summer, on hot days. Weather men think that when rain drops are formed in clouds, and are all ready to fall, they are suddenly pulled up much higher, into freezing air. The rain drops freeze but do not burst. Then they fall through other rain clouds, and more water freezes on the balls of ice. They are tossed up and down until they become so heavy that they drop like bullets. They drop so fast that they pass through the warm air near the earth without melting. Sometimes they are as big as pigeon's eggs. Find a very big one, some day, and ask papa to cut it across quickly, with his strong knife. You will find that the hailstone was made in layer rings like a lily bulb. The oyster makes the beautiful pearl in the same way. Around a hard center it puts layers of the pearl with which it lines its shell house. The hailstone pearl is just as beautiful as the shell pearl, but it melts so fast it is hard to study it.

But you can study larger pieces of ice. On very cold mornings you sometimes find a glass of water frozen. The water did not fill the glass, and was level. But the ice is pushed to the top, and into a little mound in the middle. When water freezes into ice it takes more room. Big people say it expands. In reading about land you learned that rocks are split by water freezing and expanding in the cracks. If water freezes in water pipes in a house, the pipes burst. Then a plumber has to come to mend them. Running water does not freeze as easily as still water. So, on cold nights, it would be a good thing to leave a faucet a little open, to keep the water flowing through the pipes.

Ice is lighter than water, that is, it fills more space for its weight, so it floats on water. It forms on top of water first, and freezes downward. You never can tell just how thick it is from the top. Before you try to slide or skate on a pond or river, you should take a hot poker and melt a hole through the ice to see how thick it is. And when ice is ready to break up, it gets "rotten" or spongy, first. You must always obey a "danger" sign that grown people put up on ice.

It is fine to see ice break up in a river. But keep off the bridges. The big blocks of ice crash against timbers and stone piers, and sometimes destroy the bridges. Sometimes, in fogs, icebergs crash into ships and sink them. When you crossed the ocean you may have seen icebergs as big as hills, floating in the sea. If you did you wondered how they were made.

Do you remember the ice rivers, or glaciers, in the high valleys of the Alps mountains? Away up north, where the Esquimos live, all the rivers are frozen. They melt a little in the summer, but more snow falls every year than is melted. The new snow presses on the old below, and squeezes it into ice, or very hard water rock, just as sea water presses sand into stone. This ice is pushed down the river beds by the weight above. The ice rivers reach the sea just as all other rivers do. In the summer the ice that is near the sea melts, or it becomes "rotten" and breaks off in large chunks. Those chunks are icebergs. They float into warmer water and melt.

It may have been a hundred years since the icebergs you saw were fleecy vapor clouds, riding on the wind-horses, in the blue sky. But there they were at last, in their old home in the ocean. Soon the berg will melt. Then the sun will turn it into vapor again, to begin another journey. (See WATER, OCEAN, SEA, GLACIER, WATERPOWER, etc.)

III. AIR

Besides land and water on the earth, there is something that is all around it, and all through both land and water. You cannot see it, or feel it, or taste it, or smell it, or hear it. But you can prove that it is all around you in a great many ways. You can take it to pieces, too, and find out what it is made of.

Measure your chest with a tape line. Twenty-eight inches? Now breathe deep, deeper. Hold your breath and measure again. Thirty inches! You filled your lungs with air. They were just as full of air as this glass pitcher is of water. This drinking glass looks as if it was empty, but it is full of air. Turn it upside down, and press the open end on the top of the water in the pitcher. Push it straight down under the water—steady; don't let the glass tip up. The water rises outside the glass and overflows. Lift the glass carefully. It is dry inside, except for a narrow



rim at the top. Some water did get inside, by squeezing the air in the glass into a little smaller space. See how much water was forced out of the pitcher. Nearly a glass full!

Big boys who dive and swim under water, fill their lungs with air first and hold their breath, so water cannot get into them. That is a very useful thing to learn to do. It saves people from drowning and makes them able to save other people.

Have you ever heard people say: "As light as air?" Perhaps you think air doesn't weigh anything.

Did you ever pump water from a well by working a pump handle? You had to pump several times before the water came, didn't you?



You had to lift the air out of the hollow pump before the water could come in. Pumping air is hard work. There are several simple ways of proving that air weighs something. Empty the teakettle of water and take the lid off. Now lay a sheet of rubber cloth over the top. Put a glass or rubber tube into the spout, and draw the air through the tube into your lungs. Breathe again. Suck all the air out of the kettle. See the rubber cloth sink. The air on top is pushing it into the kettle. There it goes, down inside. There is no air in the kettle to hold it up.

Now blow into a little rubber balloon. See it swell. Blow again, the rubber stretches. See how much air you can blow



into it. Ah, it burst! There was more air inside the balloon than there was outside. Fill a glass with water until it overflows. Cover the top with a sheet of thick, smooth letter paper. Press it all around the edges so you are sure no air can get between the glass and the paper, to let the water out. Now take hold of the glass by the bottom and turn it upside down. The water will not spill, the air below holds it up. Turn back to *Air* in this book and find out what air weighs.

Just as fish and sea plants may live at the bottom of the ocean of water, so land animals and plants live at the bottom of the ocean of air. The top of this ocean of air is level, too. Do you think the air on a mountain peak would be as deep or as heavy as the air in a low valley? A glass full of water has no color. But an ocean full of water looks blue. We cannot see air itself, but we can see the color of it. When it is forty miles deep air looks blue, too.

Robert likes to climb trees, so he is just the boy to get up on a step ladder and take down those dusty curtains. Warm up there, Robert? Hot air goes up, so it is always warmer near the ceiling. You remember how warm air carries vapor up to make rain? It is the hot air that carries smoke up from chimneys. Did you ever send up a red paper balloon on the Fourth of July? You lit a tiny candle at the bottom. Soon the sides of the balloon swelled and stretched tight. Air expands when it is heated. That is, it

takes less hot air to fill anything than it does cold, so it grows lighter. The balloon floated around the sky until the candle burned out.

Warm air is always going up and cold coming down. Out of doors Mother Nature attends to this pushing, but in houses we have to help, by letting the warm air out at the top and cold air in at the bottom. Air is always in motion unless it is in prison, and prisoned air is very bad to breathe. Still air is dead; live air is always in motion.

Sometimes air rivers flow up and down so rapidly, pushing each other out of place that they make—what? See the leaves blowing on the trees. Wind! Wind is air that is in a hurry. You can feel it. Draw a *quick* breath. You felt a tiny wind in your nose, didn't you? You cannot feel air, but you can feel wind, or air in motion. You can feel the temperature of air, too. Your skin tells you if air is hot or cold. You can feel if it is damp or dry. You cannot smell air, but you can smell odors in it—the perfume of flowers, the freshness of rain, bad odors of decay, or smoke. You can train yourself to tell if the air in a room is fresh or stale. Doctors always come into a sick room with suspicious noses in the air. As we have to pay doctors for telling us when the air is bad, let us see if we can find out for ourselves.

When you were up on the step ladder, Robert, did you notice anything beside the heat? You felt smothered, then dizzy? You don't feel that way on the hottest summer day out of doors, do you? Let us see what was the matter with that air.

Put half an inch of water in a pie pan. Twist a bit of soft newspaper, light it with a match and drop it into a drinking glass. Let the glass fill with smoke, but while the paper is still burning turn the glass upside down in the pan of water. The flame goes out, leaving some paper unburned. The water *rises* in the glass, much higher than in the pan outside, and stays there. Something was burned out of the air, making room for the water to rise. The part that is gone is oxygen. If you had shut a live fly in the glass it would have died as quickly as the flame. Animals and fire cannot live without oxygen. By breathing air in you burn up oxygen. It would not take you very long to use up all the oxygen in a small room. Then, if you couldn't get any fresh air at all you would "go out" like the burning paper, and the fly in the glass.

Beside using up the oxygen in the air, when you breathe in, you make a poisonous gas when you breathe out. Fire does the

same thing. Here is a bottle of clear lime water. It cost two cents at the drug store. Divide this lime water between two small fruit jars. In one of the jars hang an inch of lighted candle above the lime water, by a wire twisted around the candle and hooked over the top. Cover the top of the jar with a folded napkin. The flame goes out as soon as the oxygen in the jar is used up, of course. But something else happens, too. The clear lime water turns milky. The flame gave out a gas called carbon dioxide, or carbonic acid gas.

Put a tube of rubber or glass, or a big lemonade straw, into the lime water in the other jar. Blow your breath through the tube, into the water. You can tell when you have forced your breath in, for you make bubbles. Do this several times. This water turns milky, too, from the carbonic acid gas in your breath. Your breath is warm so it goes up to the ceiling. The air made by a gas flame, a heat register or radiator goes up, too. All this warm air has been used by fire and by people. The oxygen has been burned out of it, and carbonic acid has put into it. It would not feed a fire or a pair of lungs, and it becomes even poisonous. This is bad air. It will go out of doors if you help it, and be purified.

Beside helping to keep people well, to know about air may help them at any time to put out a fire. Fire cannot burn without oxygen, so it can be smothered. If your clothing catches fire roll up in a rug or heavy bed clothes. Keep the fire from getting air and it will go out.

Out of doors, nature is always purifying air. She does it by having plants and animals live together. Plants make oxygen and use up the carbonic acid gas that is poisonous to breathing animals. In the sea fishes and water plants help each other, in the same way. They get air out of the water. Seeds and worms and beetles get air out of the earth. If you plant seeds too deep, or pack the earth too hard above them, they will rot. So you must read the directions on your little paper of flower seeds and obey them, or you will have no flowers. You can kill little animals by stopping up their holes sometimes.

See how wonderfully this world is mixed up. Earth is solid, water is fluid, air a gas. But there is water and air in the earth, earth and air in the water, and earth dust and water vapor in the air. They all need each other, and plants and animals need all three. Air is the freest and sets everything else in motion.

Wind, or air in motion, is a great worker and wonder-worker. It tosses the tree tops, whirls the dust, carries vapor clouds to make rain, scatters seeds. It turns the long arms of windmills and sends sailing vessels flying over the water. It waits for nobody. It says how-do-you-do and good-by, and is gone. There isn't a bit of use to get out of humor with it, if it blows our hats off and turns umbrellas wrong side out. The wind can't help blowing. It is being pushed and jostled about itself. Besides it has the most important work in the world to do—keeping air in motion and purifying it. So get off the track. Wind has the right of way. See AIR, page 33; RESPIRATION, 1602.

THE STORY OF LIFE

PART I—PLANTS

EDITOR'S NOTE TO MOTHER AND TEACHER.—Often, before he can talk plainly, a little child has some sense of the mystery of life, in himself, his playmates, his bird and his dog. Later, he recognizes that the flower and tree are alive, too. He asks endless questions about life, its nature and origin. Any child old enough to put a little brown seed into the ground, with confidence that a flower will grow from it, or who sees a downy chicken or crying bird come from a shell, has a natural curiosity about them that should be and can be satisfied.

He can comprehend that all life reproduces itself by means of seeds and eggs, and grows from these simple seeds into the more complex form of the fully developed offspring. To learn this in the right way is now recognized as the most serious requirement, as it has always been one of the most difficult problems, of his education.

In this "Story of Life" we compare the forms and functions, first of plants, then of animals, from the lowest, simplest types to the highest and most complex. So far as the editors are aware, this is the first attempt ever made to present Biology, or the Science of Life, to little children, and to show them some of the more striking resemblances among plants and animals which point toward a common relationship to one Great Source. The stories are as fascinating as fairy tales. They open up to the child, a new world of wonders; a world of intelligent plan, of order, of beauty and of the brotherhood of living things. They teach reverence, sympathy, and a sense of the worth and sacredness of all life.

Because of its appeal to the imagination—particularly of the young and in the treatment of a difficult scientific subject—the dramatic form of expression is here frequently employed; as "The Earthworm Puts on Armor." But the discussion of any particular theory has been purposely avoided, because we believe it would be out of place, and because these great and sacred truths, upon which we all agree, seemed to us of so much larger importance.

PART I—PLANTS

I. WE MEET THE FAIRY GODMOTHER

What if you had never seen an apple, or an apple tree! Little Esquimo boys and girls never saw them. So, just imagine that you never saw them, either.

Then, if a traveler from a strange country should bring you a little brown seed, a green leaf, a pink blossom, a bit of the wood of the apple tree and of the bark, and a juicy red apple to eat, and should tell you that they were all parts of one plant and had grown out of each other, and were made from one common food, what would you think? Very likely you would say: "What a lovely fairy story. Please tell another one."

If he was a very wise man he might say: "Very well, here's another one just like it." He would ask you to look at baby brother. Even Esquimo children have baby brothers. See his dewy, pink satin skin. Feel the soft flesh under it, and the hard round bones under that. Feel his loving little heart beat. Look into his merry blue eyes; brush the sunny curls on his head, and let him bite your finger with his pearly teeth. Watch mama cut the shell-pink finger nails that can scratch like pussy's. Those things—skin, flesh, bones, heart, eyes, hair, teeth and nails—all so different, are all a part of the baby. They are all fed and made to grow on just one food—milk. Then, maybe you'd be able to believe that the apple tree might be a really, truly story.

And that would help you understand that all living things—plants and animals—the baby and the apple tree, all came from one seed, and are sort of far-away cousins to each other. Isn't it pleasant to think that we are related to butterflies and birds and apple blossoms? Only children, and a few very wise grown people, can understand how this can be. Children can imagine things. They can imagine what fairies would look like if there were fairies. So they can understand the wonderful true stories that science tells, about things as strange as fairies. And then children are curious, and it is easier for them to change their minds. That makes their minds

grow. The mind is like everything else in the world. It can grow only by changing.

Don't you like for papa to open the back of his watch so you can see the wheels go 'round? When he does that you want to know what makes them go 'round, don't you? You want to know how and why each part of the watch works for and with the others. A plant or an animal is more wonderful than a watch. A watch runs down, and has to be wound again. But plants and animals have little live wheels that wind themselves, and keep going as long as they live. And before they die they start other plants and animals just like themselves—or even a little better—to going.

To understand it all you will have to go a long way back. There couldn't have been a watch until there was a wheel, then another wheel to turn on that, and a spring to make them turn. So there could never have been a plant or an animal until there was a little living wheel, or cell. Did you know that men of science, who have studied life in plants and animals, have found out what that cell looks like, and what it is made of? It is just a tiny, egg-shaped bag so small that you cannot see it, except under a microscope, and as colorless as a drop of water.

Still, that little living cell has a skin or thin wall around it, and it is filled with a drop of magical jelly. The jelly is alive. What is it to be alive? A bit of sponge can soak up water, but it cannot use it, or make anything out of it. A silk worm eats mulberry leaves, grows larger on this food, makes a silk cradle to go to sleep in, and hatches out into a butterfly that lays more silk worm eggs. To be alive, is to eat and grow, and turn the food into something else and, don't forget this, make more living things like itself. That is why we know that the little drop of jelly is alive. It is the smallest, simplest live thing in the world. Of course, it is so important it has to have a name. It is called Pro'to-plasm.

The wonderful cell full of protoplasm is the fairy godmother of every living thing in the world. It is the "once upon a time" with which the story of life begins. It has done more wonderful things than to turn pumpkins into gilded coaches and mice into horses. It didn't do them all at once, just by waving a wand. It began in a very humble way, and took one small step at a time. At first it was contented to make another little round cell just like itself, then another and another and another, all as alike as so many peas. But each one of those cells full of protoplasm could

eat and grow, and keep itself wound up, and make other little cells. Then, by and by, after ages and ages, because they were alive and their home wasn't always the same, some of the cells changed a little, and they kept on changing every time they had to.

Now, every step that was taken forward from the little cell full of protoplasm, lives in some form today. So we can follow the story of life, step by step. You can find the beginning of it in a loaf of bread. When your mama makes bread—no, mama doesn't make bread, she helps bread make itself, by—but that's another story. (See CELL, CELL-DOCTRINE, PROTOPLASM, BIOLOGY.)

II. HOW THE YEAST PLANT GROWS IN A LOAF OF BREAD

Which would you rather do, get inside a loaf of bread, or put the bread inside of you?

That makes you laugh. But you never tried getting inside a loaf of bread. If you get inside before it is baked, you will find plenty of playmates. Bread dough is just full of little living cells of protoplasm. They eat the bread before you do. They eat and eat and grow, and make millions of other cells like themselves. Let us watch them. They are very active little plants so they can easily be studied.

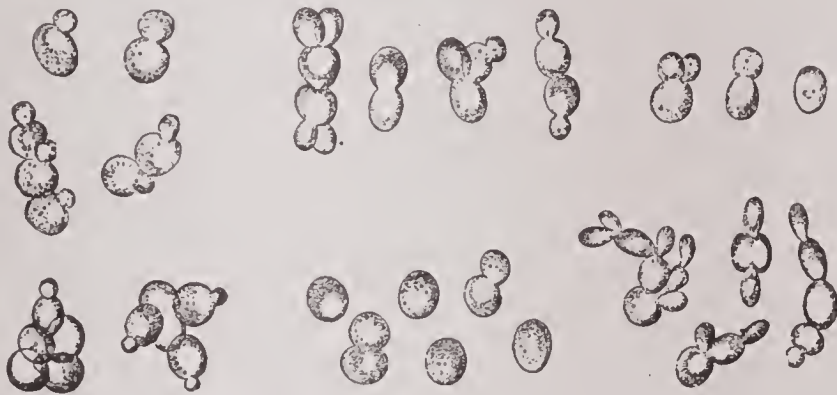
Your mama buys a yeast cake when she wants to make bread. It may be dry and hard, or it may be a soft paste wrapped in tin foil. It has an odd smell, and does not seem alive at all. Mama isn't sure that it is alive. She takes a half cup of warm water, and a little flour and a tiny bit of sugar and mixes them. Then she breaks her yeast cake into the cup, stirs them all together and stands the cup in a warm place. If you ask her why she does that, she may say: "I want to see if that yeast is alive."

Now you watch it! Soon little bubbles begin to burst. The batter swells and foams, and rises to the top of the cup. Study it with a microscope. The whole mass is in motion. Mama says the yeast ferments, but that is just another name for growing, for yeast plants. There, the secret is out. Mama made a garden. The flour and water and sugar are soil. In the soil she scattered yeast plants—just as a farmer scatters wheat seeds in a field. The yeast is a water plant and will grow in warm water alone, but it will grow faster if given the starch in flour. And it likes sugar, too, just as you do. It uses these things to grow on and, in using them, it changes them. It turns the starch and sugar sour, and gives off the same gas—carbon dioxide—that animals give off in breathing. This gas is what puffs the bread so it rises to the top of the pan. There is very little food in the cup. Soon the yeast plants will stop growing and making gas. Then the paste will fall flat. Mama must hurry and get a big pan full of dough ready, to give the yeast plants more food.

This time she takes a quart of water, and a lot of flour, and the foaming yeast in the cup. She beats the batter with a big spoon to scatter the yeast plants all through the soil and to beat in air, too.

All living things need air, you know. Yeast plants want their food warm just as the baby does; but they grow best in the dark, so mama covers the bread pan. The yeast plant is that little round cell filled with the magic jelly, protoplasm. It likes to float around in a warm bath. In some strange way it soaks food through its thin cell wall and grows larger. When it is grown up, it sprouts another little bud of a cell filled with jelly. Sometimes these buds break away from the parent cell and start a new family, but sometimes they hang together in a little knot or string of cells. The yeast plant has neither stem nor roots nor leaves nor blossoms nor fruit. Each little bag of jelly is a whole plant.

There are a great many plants on earth much like yeast, that you can find and study. One of them likes bread after it is baked.



Yeast, showing single cells and how they grow and multiply by budding.

It is blue mould. Blue mould grows on old bread, and on the top of glasses of jelly. Under a microscope it is very beautiful. It is a feathery mass of delicate blue threads. Black moulds and mildews, rust on wheat, black smut on corn, and puff ball smoke, all belong to the same family of plants. Cells of these kinds of plants are always in the air. You can make a garden of them by leaving a saucer of flour paste, fruit jelly, or a bit of stale bread exposed, for a week or two.

They have a family name. They are called Fungi (fun-ji). The blue mould is often called Fairy Fungi. It looks like a fairy forest. Toad-stools and mushrooms are fungi, too. The fungi all have one very bad habit. They don't earn their own living. They live on other plants, and even on animals. But they like dead or dying things best. Around old trees and fallen logs you will find toad stools and mushrooms. There are two ways in which you may know the fungi. They live on some other living, or dead and decay-

ing, plant or animal, and they are never green. They do not have stems or roots or leaves or flowers or fruit or seeds. Any tiniest cell of a fungus, if put into the right soil will grow and multiply cells, just as the yeast plant does in the batter. It is the very lowest order of plants.

But it became a higher kind of plant when it had to. Fungi like the dark. The first plants were born in the dark of deep sea water. You know earthquakes lifted the floor of the ocean. The



Mushroom, which is one kind of fungus.

plants were lifted, too. As the plants came near the surface of the water they got more light. Do you know what sunlight does to plants? Did you ever find a board lying on the grass? The next time you find one, lift it. You will find that the grass under the board has turned yellow or white. Now, you know that a part of the grass wasn't *born* green and part of it white. The outside

leaves of a head of cabbage or lettuce are green, while the inside leaves, shut away in the dark, are white. Sunshine turns plants green. Nature took as long a step upward as the giant who wore seven league boots, when the first sea plants got enough sunlight to turn green. Green plants were lifted clear out of the fungi class. They began to earn their own living for one thing, and they learned to do a lot of things.

Now, nature might have made one kind of cell and magic jelly for the fungi, and another kind for green plants, but she didn't. She seems to like to see how many different things she can make of a few simple things. All the plants and animals begin to grow in a little cell of protoplasm. So, when we understand the fungi, the simplest of all plants, we have learned the A. B. C.'s of life. Knowing the letters, we can spell the words and read the story of the living world. (See FUNGI, YEAST, MOULD, MILDEW, RUST, SMUT, MUSHROOMS, TOADSTOOLS, etc.)

III. SAILOR PLANTS AND ROBINSON CRUSOES

The first little plants were sailors. As they floated about in the water, the living drop of jelly or protoplasm, soaked food through the thin walls of the cells. One cell budded from another, and broke away to start a new family, or clung to the parent cells in a bead-like string, or in a knot that floated together. Then they budded all around the sides and formed mats and flat net-works of cells, held together by a gelatine in the cell walls.

Some of these nets and mats floated on rocks, in quiet places where the motion of the water was not strong enough to float them off again. As the rocks sheltered them, the plants were not so easily torn apart. The cells that lay on the rocks could not gather so much food, so they learned to cling. The free, floating cells gathered food, and budded and spread into feathery, leaf-like fronds. The plants lived in a colony, you see. So, by and by, they divided the labor just as people do in a village. It was the business of some plants, or cells, to cling to the rocks. Others waved in the water and gathered food. It wasn't necessary, any longer, and there wasn't room, for each cell to bud, although it could have done so. Certain cells began to collect budding material, in little raised dots on the fronds. When these dots ripened they were washed off. These bud dots were spores. They were not seeds, they were just the hints of seeds; and the cells that clung to the rocks were hints of roots; and the cells that spread out and floated were hints of leaves. All together they formed—seaweeds! Seaweeds belong to a family called algae. Algae are higher plants than fungi. But these colonies of cells did not deserve to go into a higher class until something else happened.

Some of these plants were born near the surface of the water where there was more air and sunlight. The sunlight turned them green. A green plant can take raw material like earth, air and water and, with the aid of sunlight, make its own food. Algae are found in oceans, rivers, lakes, ponds, marshes and warm springs, everywhere. Some of them are very beautiful, in a great variety of forms and colors. The very commonest algae that you can all find, almost everywhere, is the green scum that forms on quiet ponds and swamps. Scum is all broken up into single plants, or knots and

strings of cells, and can be easily separated and studied under a microscope.

There were some seaweeds that did not have a chance to become green. They grew far down in the deep sea, under tons of dark, almost airless water. They lay on rocks, flat and motionless and sluggish. They grew slowly but were hard to kill. They learned to live in colonies, to cling, to spread, and to grow spore buds, so they were a little above the fungi. By and by they were lifted, with the rocks they grew on. You know earthquakes lift the ocean floor. Parts of the deep ocean floor have been lifted suddenly into rocky islands. When that happened these colorless seaweed colonies were lifted, too, and shipwrecked in the air. They were just like Robinson Crusoe.

They wanted to live. If you were lost in the woods you would hunt roots and berries and nuts. You would strike stones together to make a spark and start a fire. You would make a bed of leaves in a cave. You would do your very best to live, wouldn't you? Robinson Crusoe was lost on an island a long time. He had to do many things he had never done before, and he changed so much that his best friends wouldn't have known him. If those deep-water seaweeds had been lifted slowly, to the air and sunlight, but still kept under the water, they would have become green algae. But they were castaways on the land before they got far enough along to be algae.

Most of them, millions and billions of them died. But those that died, decayed, mixed with the sand or rock waste and made the first soil that covered the bare rocks. Some of the water weeds managed to live by clinging to the rocks and decaying plants. But, like Robinson Crusoe, they had to learn new ways of living, and they grew to be very different from the algae, their water cousins, and different from the fungi, their ancestors.

For one thing, they became very dry and gray. They spread in broad scales to turn as many cells as possible to the air and rain. But they never turned green. You may find such plants today, on the rocks of the highest mountains, under the snows of cold countries, where grass will not grow, on dead or dying trees and fence rails, and on old house shingles. And, scientists tell us, they are to be found on the deepest rocks in the sea. They are called lichens. (li'kens). Some people think lichens are dry mosses, but they are not. They are plants between the fungi of the yeast and

mildew, and the green algae of seaweeds. They are shipwrecked sailors, who learned a new way of life through many hardships.

Like the fungi, lichens live on other plants. They cannot get their own living. But, like the algae, they have learned to cling, to spread into leaf-like fronds, and to form spores or bud cells. In them is a hint of coming roots and leaves and seeds. They are often beautiful and are always curious. They are generally flat, dry, crinkly-edged scales, colored gray or silver or black. Sometimes, on old tree trunks, they are in thick, fluted ridges, and colored yellow or bright orange or white. With a microscope you can see that the gray scales are powdered with dusty round dots. Those are the spores or bud cells. When ripe the wind blows them, or the rain washes them away.

There is another thing the lichen has learned. Unable to turn green and so make its own food, it often goes into partnership with its higher born water cousin, the algae. It does it in this way. The lichen is made up of a network of thread-like cells. Each mesh holds a little water. Algae spores, floating in the air and looking for water to grow in, find enough for just one cell, perhaps, in each mesh of the lichen. So they promptly move in. Often there are so many algae plants on the gray net surface of a lichen, that they turn it to a soft sage green color, very bright and moist. The algae being green, collect food from the sun and air and feed the lichen, and the lichen covers the algae with a network of gray thread cells to keep it from getting too dry.

Nature makes many partnerships between plants and animals that can help each other. Bees and butterflies help the flowers grow seeds. Men help plants to grow, and make friends of horses and dogs. Isn't it wonderful that, as low in the scale of life as algae and lichens, we should find this water plant and its shipwrecked cousin helping each other? (See ALGAE, LICHEN, CHLOROPHYCEAE, CHLOROPHYLL.)

IV. WATER BABIES THAT LIVE ON LAND

Did you ever see a tad-pole? A tad-pole is a baby frog, you know, but it looks more like a baby fish. It breathes through feather-like gills. You can keep one in a gold fish bowl and watch it turn into a frog. Behind the gills a pair of little flippers pop out. They grow into legs. Then the gills go inside and become lungs. The hind legs come next. The tail grows shorter, and the animal broader. One day the tad-pole is gone. The frog jumps out on a rock and catches an insect for dinner. He sits blinking in the sun as if he wonders how he did it. The frog is a land animal that grew from a water baby. It likes to live on the edge of a pond where it can dive and swim whenever it feels like it.

There are plants something like that. They were born seaweeds or algae. You remember that some of the algae were so near the surface of the water that they turned green in the sunlight, and became able to make their own food? Many of them were lifted slowly, on rising seacoasts until, at last, they found themselves in the water part of the time, and part of the time out in the air. If these algae were to live, they had to jump from swimming tad-pole seaweeds into—not quite, but almost into froggy mosses with legs, and air-breathing lungs. They became those curious plants that we know as liver-worts. Like frogs they can live only in wet places; on tide-water faces of cliffs, on rocky river banks, around ponds and springs and even floating on patches of quiet water in marshes.

He-pat-i-cae is the book name of liver-worts. That is confusing, because there is a little pink flower that blooms in the woods and meadows in the spring, that is called the hepatica. We won't say he-pat-i-cae again, and we wouldn't say it even this once, if you didn't need to turn back to that word in Volume II, page 865, of this book, to see some pictures, and to read more about liver-worts. There, a scientist who has made a study of life in plants and animals, says: "The liver-worts were probably derived from the algae and, in turn, have given rise to mosses and ferns."

Very likely this is the way the algae managed to turn into liver-worts. You remember the algae learned to cling to rocks, to spread into feathery fronds and to grow bud cells or spores. These are hints of roots and leaves and seeds. If you lift a frond of sea-

weed from the water the hair-like cells will all fall together, so they look to be one narrow blade-like leaf. Every time the tide-water drops away and leaves seaweeds out in the air on rocks, the fronds fall and mat together.

After being left out a great many times, some of these frond cells learned to cling together, even when the waves washed back over them. The scattered strings of cells went into partnership and became a leaf. The clinging cells on the underside of the leaf grew into longer, stronger hairs to anchor the plant more firmly to the rock. They learned not only to cling, but to suck up water to feed the cells above. Then the little spore buds raised their heads, and tried to grow into something that would attend to the business of starting new plants better.

Liver-worts look much like very green lichens or very flat mosses, but they can easily be told from both. No lichen is so green and moist, and the smallest mosses have true stems and roots. The liver-wort is just a mat of tiny, flat leaves. One leaf grows out of another, without a sign of a stem. The whole plant is just a thousand leafed mat. The upper side is the stem and leaf and flower, all in one. It is green, and can make food out of sunlight and rain and air. The lower side is white, and from it grows little thread-like, white hairs that act as anchor cables and water suckers. Every leaf that sprouts sends down its own little rootlets below, and grows spore cases on top.

Every part of this flat, mossy little liver-wort is so small that you will have to put it under a microscope to find out how wonderful and beautiful it is. You will find the leaves clearly marked; each a round, flat, green scale with curled up edges, and spotted with darker green. These spots are raised above the surface, and are of two different shapes; but you will never find both shapes on one leaf.

One of these spots looks like a tiny umbrella, upturned and fringed with spun-silk threads. Between the fringes peep little green cups or bottles with balls in them. They look as if they were waiting for something. They are. On the next leaf, perhaps, the raised spot looks like a toad stool with a star shaped top. It starts to grow from the under side of the leaf, curves around the edge, and suddenly stands up straight. On its flat top are little pocket holes.



In each pocket is an egg floating in a bath smaller than the tiniest dewdrop. The egg is full of cells, that are scattered in the water when the egg bursts. Each of these cells has two little whip-lashes that thrash around in the water like wiggle tails. They seem to have minds of their own and to know just what to do. They make straight for the mouths of those bottles on the umbrella spots, whip themselves inside and find the little balls. The ball and the whip lash cell unite, and make spores.

The spores of the liver-wort are not exactly like flower seeds. They are really cases of spores, like the single spore grains on lichens and seaweeds. The plant has taken all that trouble just to be sure there will be enough spores to grow more plants. When the cases are ripe they burst, and the spores are carried on bundles of long threads that snap and scatter them. The liver-wort seems to like to use whips to drive itself along.

What wonderful changes from the simple-celled algae floating in the water, or waving from its rock anchor! The liver-wort has made a leaf; it has dreamed of a root, in its white hair-like suckers; and it has whipped and lashed itself into storing its spore cells into a sort of seed case.

Like the frog that grew from the tad-pole, this water born baby must sit and blink in the sun and wonder how it did it! (See HEPAT-ICAE, SPORE, FROG.)

V. PYGMY PLANTS AND THEIR WONDERFUL LABORS

Next above the liver-wort, is a plant that will tell you how to find your way home if you ever get lost in the woods. One of the very first lessons a little Indian boy learned, when he went hunting, was that moss grows mostly on the north side of trees. It does that because the north side is damp and shady. If liver-wort is the child of the algae, or seaweed, moss is the grandchild and the fern the great-grandchild. They all like plenty of water, each one needing a little less water, and able to bear a little stronger sunlight. Each next higher plant learned new things. The liver-wort learned to grow leaves, to send down little sucker hairs and to fill spore cases. Let us see what moss learned to do.

Moss grows from a spore like the liver-wort. It nestles in any damp, shady spot it can find; on a porous rock or the bark of a tree, or on a soft bit of ground. At first it grows little strings of green cells, very much like its grandmother, the seaweed. These lie flat. They seem to be food cells for little brown rootlets that burrow into the soil, and for buds that rise in the air.

It doesn't matter at all which side of the moss-spore lies on the ground. The strings of food cells spread around it; the rootlets go down from the underside, and the buds rise from the upper. Neither the root nor the stem are in the spore at all, only cell material, whose business it is to get food from the earth and the air. The cells on the ground burrow for food, and the upper cells reach for it. The interesting part about moss is that the upper growth does not flatten into a leaf, that sprouts another leaf, like the liver-wort. It grows upward into a little stem, and leaves sprout from the stem. It grows upward, oh, quite a little bit of an inch, budding leaves all around the stem, and finally bears a little seed case on the tip.

Bravo! Don't you feel like clapping your hands? Think how long and hard those little yeast cells full of protoplasm had to work, before they could make the moss plant with a true root, a stem, a leaf and a seed case. But when it has done it moss is still such a tiny fairy plant, and so slender and delicate that it cannot stand alone. You always find the mosses crowded so closely together that they make green plush cushions. This is partly so that the little

plants can hold each other up, and partly too, perhaps, so the spongy matted mass can hold plenty of water. One little moss plant, standing alone, would soon become very dry. If you want to separate one plant from a cushion of moss you will have to melt the earth out in water, until the little rootlets can be pulled apart.

There it is, at last, a pigmy pine tree, with a sort of cone-shaped pod on the tip. This is often called the moss fruit, but it isn't a fruit as seeds of higher plants are. It is a spore case, very much like those of the liver-wort. But here is a funny thing. Moss makes seed first, and then a spore case. The seed is borne on the tip of the stem. It doesn't burst or fall off, or go anywhere. It just begins to grow right where it was formed. It sends a little anchor root down into the mother stem, and a bud upward in the form of a little leafless stalk. (See picture in Volume II, page 1282, *Musci*.) On the tip of the stalk is set a pointed and fringed fool's cap. That is a spore case. Mosses, like liver-worts, grow from spores. The spores make true plants with root, stem, leaves and seed. But the next plants do not grow from these seed. The seed stay on the parent plant, and make spores to grow new plants.

All the strength and cleverness of the moss plant goes into making these spore cases on the tip. (See MOSS CAPSULE, page 1283.) The fool's cap is really only a husk, like the chaff of wheat. Underneath it is a cup, with a curly hair-fringed rim, and a cone rising from the middle. The cone is pitted in regular ray-like rows, something like the tip of a baby ear of corn before the grains come. In these cups are the same little balls as in the liver-wort. On other plants nearby and mosses, you know, so closely crowded together that they seem like one plant, there are other cups in which those double lashed whips thrash around in a bath. You can easily guess what they do, for it is the story of the liverwort all over again. The whip cells find the ball cells, and the two unite to form spores. When the spores are ripe the cases pop open. The spores are carried away by the little hairs set around the rim of the cone.

Having made a leaf, a root, a stem and a seed, what was the next thing to be done? You remember the stem of the moss is very slender and soft. It couldn't grow very high, nor stand alone, nor keep itself from dying. Just as the green cells of algae live in colonies, and so form fronds or feathery hints of leaves, so moss plants live in colonies to protect each other. The next step for these baby plants is to learn to stand alone. See Moss, *Musci*.

VI. HOW THE FERN GREW BONES AND BABIES

In order to stand alone you must have a backbone. And you must have bones in your legs, too. Your bones are on the inside and are covered with muscles. A turtle's leg bones are on the inside, too, but it carries its backbone on the outside. The turtle's backbone is its shell. So you won't be surprised to learn that trees carry their backbones on the outside, in the form of bark. But it took a long time for plants to learn to make bones on the outside.

Did you ever find it hard to break the stem of a field daisy, wild aster or golden-rod? Such stems seem to be made of bundles of tough threads. They are called fibres. The fibres of the flax stem are so strong and fine they are woven into linen cloth. The stem of a fern leaf has so many of these tough fibres packed together that it is like wire. Fibres are strings of cells. Each little cell has a thin wall around it like the yeast cell, through which water can easily soak, and air pass. The plant used these strings of cells at first to soak up food and air, then to cling to rocks, then to make leaves and stems and roots and spores and seeds. Finally she bound them in bundles to help her stand alone.

The fern is nature's first effort to make bones in plants. The fern stem is very slender and bends easily, so easily that the single feathery leaf on its tip, sways in the wind like an algae frond in the water. We often say fern fronds because of this likeness. But they are not fronds. They are true leaves.

There was a time, ages and ages ago, when ferns were the highest kind of plants that grew. For a long time, nature just tried to see how many thousand varieties of mosses and ferns she could make. Most of them have disappeared as higher forms of life crowded them out, but there are still about four thousand kinds of ferns on earth. Some of them are rock ferns, almost as small as mosses; some are as big as trees. You can see tree ferns in the green houses of city parks, and there are whole forests of them in many hot countries.

When the seed of any plant begins to grow, the first little shoot is so soft that you can mash it to a green paste between your fingers. Even a sprouting oak or maple is as soft as that. It has no bark. The cells have not even hardened into fibres. The fern leaf starts

as a little spiral, like a green snail. It does not grow from an upright stem like the moss leaf. It is just as if nature said: "I cannot make a stem strong enough yet to stand up and bear many leaves. So I will just flatten and bury the stem, and make a broader crown. From that a stronger root can burrow into the ground, and many leaves rise into the air."

The stem of the little curled up snail-like leaf is soft and green, but it is quite thick. As the leaf uncurls, this stem seems to stretch, and grow more slender. Slowly it stiffens. The strings of cells that were simply water pipes and lungs, also become bones to hold it up. These bone tubes run right out to the tips of the leaves, growing smaller and smaller, as they have less to support. Then, from the sides, grow ribs, just as your ribs grow from your backbone. The



stem of the fern leaf is a hint of a coming tree trunk; the veins in the leaf are hints of branches on the trunks. The fern leaf is really the far-away promise of a forest tree. Most fern-leaves are deeply parted between the ribs, clear down to the main stem, making branching leaflets. And on the very ends of the smallest leaflet veins, around the edges, the fern leaf bears its fruit, or spore discs, just as the most perfect rose tree bears its flowers and seed pods.

Find a fern leaf that is fully grown, in some shady spot in the woods. All around the edges of the underside, you will find little rusty spots. These are very regularly spaced, so you can easily guess there is some plan. If you look at them through a microscope you will see that they all grow from the ends of the veins, and are connected with the mid-ribs of the leaflet, and those mid-ribs with the main stem. (See FILICALES, Volume II, page 661.) So all those little rusty spots are fed from the root in the ground. The rust spots are only tiny, pin-head grains, that look like a brown powder. But you will find them fastened tight. The microscope shows them to be little brown cases, filled with still smaller grains. These are spores, like those on the liver-wort and moss. Around each spore case is hung a necklace of crystal beads. These draw together, tighter and tighter, until they force the spore case to burst open, and shoot out the ripe spores.

You remember moss first made seeds, and then used the seeds to grow spores, to grow new plants. The fern turns right around. It grows spores first. Then it uses the spores to grow seeds to grow plants. You can watch it do this if you have a great deal of patience, and a good magnifying glass. Take a bit of fern leaf and lay it on a pot full of soft, rich earth. Keep the earth moist and in a dim light. As the fern leaf decays and the spore cases burst, you may see the little scattered spores swell. They are soaking up water. One of them is sure to crack open and show a little white tip. That is a plant cell. Like the yeast cell it has a thin skin, and it is filled with jelly protoplasm. One cell grows out of another, like a honey comb. The cells spread and spread, until a heart-shaped leaf is formed.

The leaf lies on the ground, and it acts exactly like the leaf of a liver-wort. The upper side turns green, while from the lower side little hair-like suckers go down. Then little dots lift up their heads. These are cups and bottles just as on the liver-wort and mosses, too. In one kind of cup is a ball or egg, and in the other kind is the whip lash. The egg is called an ovule. It takes an ovule a certain time to become ripe, just as the egg in a chicken takes time to make a yolk and a white and to put a shell around it. The whips seem to know when the ovules are ripe, for they thrash around in the water in their cups, and finally flash across into the ovule cups. They cling together with a gelatin on the ovule, and grow together into—seed!

The fern seed use that heart-shaped leaf grown on the ground by the spore for food, and begin to grow right away. They sprout just like all true seeds, sending cells down for roots and up for leaves. The crown of the root is the buried stem of the plant. In the leaf stems the cell walls lengthen and stiffen into woody fibres. In some way that no one understands, the air and water pipes of the plants learn also to do the work of bones strong enough to support long feathery leaves. Besides, the fern is the first plant that grew from seeds. The mosses make seeds and then go back to spores to make new plants, but the ferns make spores first, and then seeds to grow plants. After the ferns, plants had no further use for spores. Having learned how to make seeds they all make them directly. Seeds are embryo, or unborn baby plants. The fern took two steps forward. It made leg and arm bones, and it made seed babies. (See FERNS, FILICALES, SEEDS.)

VII. HOW FAIRY FUNGI TURNED INTO A DANDELION

That was a great day in your family when you stood alone for the first time. It was just as great a thing in the plant world when the first fern leaf lifted on its slender stem and stood alone. Its little bones were still very soft and weak and tender. But see how long it took Mother Nature to get up to the standing alone stage of plant babyhood.

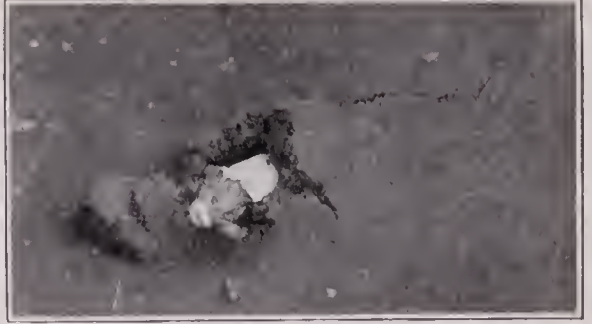
Everything in nature, among plants and animals, grows slowly, just as a baby does. It takes a baby a year to grow strong enough to stand alone, sometimes. A further time is needed for baby to learn to walk, and twenty-one years for him to grow to a man. After she made a fern leaf stand entirely alone, on a very uncertain, wobbly stem, it took thousands of years, through many, many, slow changes, to make a tree, with a stiff trunk, with stout bark, many branches and leaves, and the perfect flower and fruit.

In every upward step taken by plant life there is a story, just as interesting as the stories of the cell, the fungi, the green algae, the liver-worts, the mosses and the ferns. It would take a big book to trace all of these steps. We cannot do that here, but we can follow the big steps, in one short chapter, so you may always know in what very large class any plant you may see, belongs.

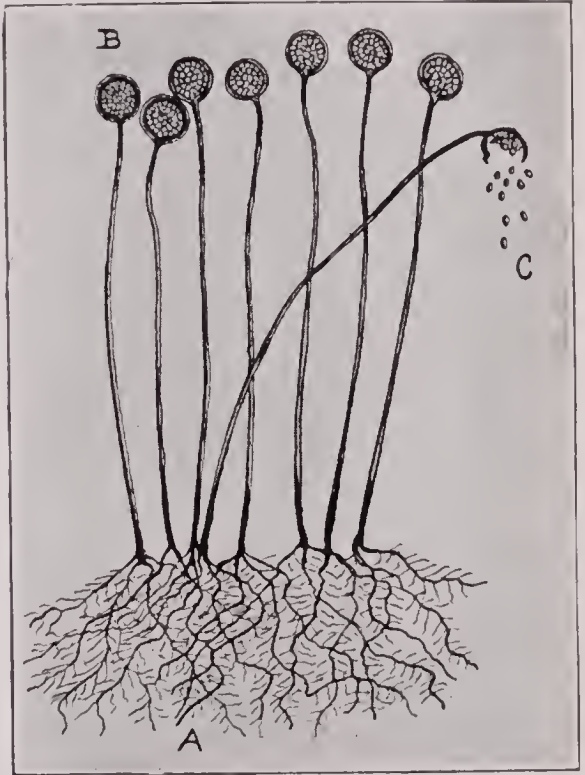
For a long, long time, Nature just made larger and larger ferns, with taller and stiffer stems that were able to hold up a great number of leaves. At last she made tree-ferns, with tufts of leaves on the tops. These plants have no flowers, but bear single, naked seeds. Next, Nature seemed to learn to put a number of naked seeds on a spike or cone. There are two branches of this family, the pines and the palms. In many ways they are alike, but in some they are quite different. They both have a tall stem, made up of bundles of straight fibres. In the palm this trunk does not branch. In the pine the branching is high and scanty. Both have straight-veined leaves.

You know the clusters of needle-like leaves of the pine, don't you? They are not so very different from the fan-leaf of certain palms. There are many varieties of pines, or what we know as evergreens, or cone-bearing trees. There are the spruces, the hemlocks, the cedars, the cypresses, yews and firs. The giant

SOME PRANKS OF FAIRY FUNGI



This lady is sitting beside a "vegetable sheep"—a huge fungus of New Zealand. On the right is a photograph of a fungus which broke through a weak spot in an asphalt pavement. What is called "growth pressure" is known to reach 20 atmospheres, or 300 pounds to the square inch.



This curious fungus is found in the jungles of Java. It is called the "net bearer." Why? The illustration on the right shows how the common fungus grows—"A" roots; "B" fruit; "C" how the spores are scattered.



Here are two ways in which the fungus attacks and helps to destroy our beautiful trees.

redwoods of California are cone-bearers, too. They all have straight-grained, soft wood, and bear their seeds in scaly cones. Each hard, woody scale of a pine cone bears a pair of naked seeds. These seeds are one-leafed, like a grain of corn. That is, the new plant grows from one side of the seed. In higher plants, like peas and beans, the seed split into two leaves.

The palm, in some ways, is simpler than the pine. It has less bark, and its stem does not branch. Its bark often seems to be mere bundles of loose, dry fibres left by leaves that fell as the stem grew upward. These leaf scales are easily stripped off, and the fibres are so long and strong that they can be woven and twisted. They hint at true bark. The flowers of palms are borne on a fleshy spike at the top, between the cluster of feathery leaves. They are small and green, as in the pines, and do not look like flowers at all. The seeds of palms and pines form very much as they do in the fern, but the little whip-lash turns into yellow grains of pollen. The making of pollen was a big step forward. Pollen grains can be carried like dust on the wind, to more distant plants. Sometimes, in the desert, the pollen of date palms hover like a yellow mist over the trees. You can see this yellow dust in pine woods in the spring. It has a spicy smell.

The pines and the palms are very useful to men. The pines furnish many building woods, tar, turpentine, resins and gums. The palms furnish food in dates, cocoanuts, sago (a starchy pith), sugar, oil from palm nuts and cocoanuts, dyes, gums, building material and fibres. In pines and palms, nature made plants of very much longer life than she had ever made before. Some giant red-woods of California are known to be hundreds of years old. The highest of the cone-bearers have very strong, thick bark and show rings of yearly growth in their wood.

Next, nature began to cover her seeds. The seeds were still single leafed, and the leaves straight-veined. She began to make ribbon-like leaves growing at regular distances on stems. Any little grass plant is an example. How many ribbon-leafed plants can you think of? Wheat, oats, rye, rice—yes, all the cereal grains, from grasses to the tall, wide, banner-bladed corn stalk. Sugar cane belongs to this family, and your bamboo fishing pole. Water flags, rushes and cat-tails belong to it, too, and onions, lilies and other bulb plants. In the bulb plants the stems are crowded into round fleshy crowns that are often buried. And they bear beautiful flowers.

All these plants, too, have single-leafed seeds. Plant some grains of corn. After they begin to sprout pull them up, one every day and watch them grow. The plant sprouts from one side of the grain, always. The first shoot looks like a blade of grass rolled from one side to another. The leaf and stalk veins lie side by side in long straight lines. The plants have no true bark, or rings of growth. Most of them live only one season. Their seeds are fertilized by pollen carried by the wind, as in palms and pines, and like them are borne on stalks or spikes. A head of wheat or an ear of corn is something like a pine cone, but the seeds are covered and protected. This class of plants gives us a great variety and quantity of grain foods, for men and animals and birds.

Last of all, Nature made plants with the two-leafed seeds, net-veined leaves, hard-wood stems that always show rings of growth, stiff bark, beautiful flowers and fruit. The very earliest of these still have wood only a little harder than pines and palms. And they bear their seeds on soft, feathery, or furry cones or spikes. These are the willows, alders and poplars with their tassel-like catkins. Far above these are the crown-bearers, or true flower-making plants. These are the orchard trees, rose bushes and strawberry vines, with their loose, gaily colored, fluttering petals. Their seeds are not only covered, they are often buried in fruit pulp, or hidden in pods and shells.

Very likely you think the crown-bearers are the highest of all plants. That is because you think of them as the most useful to human beings. But they are not more useful than many of the grasses and palms. By "highest" in plants and animals, is meant those that are most useful to themselves. It is the first business of every living thing to eat and grow and reproduce itself. Those that can do these things best, that can live and grow under the hardest conditions, and that can make and scatter the greatest number and hardiest seed, are the highest of all.

So, above the crown-bearers are the funnel flowering plants of the morning-glory and clover. And above them are the composite flowers that live, great numbers of them, packed and crowded into one flower head, like people in a city. These are the daisy, the sunflower, the chrysanthemum, the aster, the purple-headed thistle, the—guess! A little flower with a gold crown on his head—the common yellow dandelion!

If you don't believe it open a dandelion head in full flower. Split the green cup down one side and spread the head open. See

the tiny stems crowded in that cup, like flowers in a vase. Every yellow petal is a funnel that is folded around little seed-making hairs and knobs, powdered with yellow pollen grains. Try to count the ripe seeds on a gray, gauzy globe of dandelion. Watch them fly and scatter in the air. The seeds are not only well covered, but they have feather wings. You know how hard it is to kill dandelions out of grass. If you cut off the tops, new tufts of leaves spring up. If you dig out the roots some rootlets or root-tips remain to start new plants. And every flower head grows and scatters dozens of seeds. The thistles are just as bad. This family gives us some beautiful flowers, some plants that are useful, but a great many that are troublesome weeds, that we have to rout out year after year. Of all the plants those that bear composite flowers make the best fight for life, and win out under the hardest conditions. So they are the highest.

So you see how the single yeast-cell, that is born, grows to full size, sprouts a new bud and dies in a moment of time, has developed into the hundred-flowered, tough and stubborn, yellow dandelion. See GYMNOSPERMS, CONIFERS, PALM, DATEPALM, GRASS, WHEAT, OATS, RYE, RICE, BARLEY, CORN, PLATE OF CEREAL GRAINS, Volume III, page 1650, BAMBOO, sketch of Filipino in "Travel Stories" for uses of bamboo, LILY and other bulb plants, MONOCOTYLEDONS (single-leafed seed), DICOTYLEDONS (two-leafed seed), COMPOSITAE, DANDELION, THISTLE, etc.

VIII. WHY PLANTS ARE LIKE SQUIRRELS

Did you ever see a squirrel gathering acorns and nuts in the autumn? All summer long squirrels eat their food as they find it, bring up their babies, grow fat themselves and play a great deal. But when the first frost sends the nuts rattling to the ground, they know winter is coming. So they lay away a good store of food, in some safe place, to last them through "hard times." Wise little brother of the tree tops! How busy he is, and how hard he works!

Plants are just like squirrels. They eat and grow all summer, feed their flower babies until they are ripe seeds, then they store food to last them until the Spring. It is not so easy to catch plants at work, as it is to catch squirrels, but if you have very sharp eyes and minds you can do it. All plants above the fungi, earn their own living. In all green plants the roots get food from the earth, and the leaves get food from the air. The two kinds of food come together in the leaves, and the sun mixes and changes them into plant cells.

In the story about water you learned that water never runs up hill. Then how does water get from far down in the ground to the top of a tree? It doesn't *run* up; it is *pumped* up. Get a basin of water. Hold your handkerchief so just the hem on one side of it is in the water. That becomes wet at once. Hold it there. See the water climb, thread by thread! In a little while the handkerchief is wet to the top. You know a wet piece of cloth dries rapidly in the sun. As the water in the handkerchief passes into the air as vapor, more water is drawn from the basin. After awhile it is all soaked up. The basin is empty, and soon afterwards the handkerchief is dry.

This drawing of water up by threads, is called capillary attraction. A lump of sugar has it. Hold a lump of sugar with one tiny corner of it just touching the top of a cup of coffee. Soon the whole lump is brown and wet. A plant is like a big handkerchief full of threads that run from the root hairs to the leaves. The sun draws the water, in vapor, from the leaves, and more water is pulled up just as long as the roots can find any in the earth. Those little wood-fibers that you

found in bundles in the stems of fern leaves, are not only bones, they are blood vessels, too.

Those little tubes are so small that they cannot carry anything but liquid food. The sap of trees looks like clear water, but it has a great many things melted in it. The sap of maple trees has sugar. Some saps are puckery, some spicy. In the earth are many things that melt in water. Water will take up and hold, salt, sugar, lime, iron and many minerals. When clear well water is boiled in a tea-kettle, it coats the inside of the kettle with lime. If you melt salt in water and then put it in the sun, the water will pass away as vapor, but the salt will be left in the glass.

Minerals will not burn. If you burn wood you have a little heap of ashes left. The ashes are the minerals that were in the wood. Plants do not like rain-water as they do well-water. They must have water that has gone down into the earth and taken up minerals. That is the reason why plants are so made that they get all their water through the roots.

You might think that plants drink the rain that falls on their leaves and stems. They don't. They merely use rain to wash their faces. They need to wash the dust out of their skin pores, just as you do. Ask them if this is not true. Leaves will talk, as they are supposed to do in fairy stories, if you know their language. This is one way to ask leaves if they drink through their leaf-pores, or through their roots.

Take a leafy branch. Lay it across the mouth of a jar of water, so some of the leaves dip into the water. In another jar put the stems of leaves in the water. These stay fresh several days, and drink the water, as you can see by the smaller amount in the jar. The others soon wilt and wither, and do not use the water in the jar.

The work of the leaves is to do the air-breathing for the plants. They do it just as you do, through lungs. Their lungs are more like the pores of your skin. There are little open mouths at the ends and crossings of the little tubes that come up from the roots. In net-veined leaves, like the rose and apple, they are scattered over the under surface. They open little mouths, breathe out the vapor of the water from the roots, and breathe in the air.

The leaves are little plant-food factories. In them they have water and minerals from the roots, and oxygen, nitrogen and carbon-dioxide from the air. Oxygen is a purifier. We use oxygen to purify the blood in our lungs. Carbon is the wood-fiber maker. It

is that solid part of a plant that makes a bright fire. Coal is nearly all carbon, and coal you know was made of plants pressed to a kind of stone. Nitrogen is a plant food. The roots get some of it out of the earth, and the leaves get some out of the air. Nitrogen is what is left when the oxygen is burned out of the air. (See AIR.)

A leaf is very thin. The sun can shine right through it, for the cell walls or skin is as transparent as glass. In some way sunlight mixes with the water and minerals from the roots and the oxygen, from the air, and makes green plant cells. The clear, unused part of the water is drawn away in vapor, and most of the oxygen is given back to the air for animals to breathe. The carbon is laid away in the plant cells. The nitrogen is sent clear back to the roots to make nitrates, before the plant can use it. Clover draws a great deal of nitrogen from the air, to make this plant food.

The new plant food made in the leaves is sent back to all the growing parts of the plant where it is needed. Some of it stays in the leaves to build them larger. Some goes into flowers, fruit and seeds. In grasses and straight-veined plants without bark, the new plant food goes to every part. But in plants that grow by adding a new ring every year, the green cells form a layer between the old wood and the bark.

You can find this soft, green layer under the bark of a rose bush, or the twig of an orchard or nut tree, in the spring. It loosens the bark so it can easily be peeled off. That is why you can make a willow whistle in the spring, or peel a little switch. The new green layer makes the heart wood just that much larger, so the bark has to stretch to fit it. You know your skin stretches as you grow larger or become fatter, doesn't it? Maybe this stretching, year after year, is what makes the bark on hard wood trees crack in long deep ridges.

All summer a plant is busy feeding itself, growing and bringing up seed babies. But in the fall the leaves close their mouths and stop pulling up water. They know hard times are coming, when there will be little water to draw upon. So they must stop giving water to the air. They seem to rob themselves of the food they no longer need, and to send it all into ripening seeds, into the roots, and into next year's leaf-buds that form at the base of the leaf stalks. Food for the seeds, when they begin to grow, is stored in fruits and nuts, into thickened stems like lily bulbs, into tubers like potatoes, and into grains of corn and wheat. Everything is done to keep the plant alive over the winter, and to give it a new start in the spring.

When you see bare, leafless trees blowing in the winter gale, and often loaded with snow, they look dead. But they are only asleep, like the squirrel and the bee, with their food safely stored away. On any bit of twig you can find little brown knobs and points, often smaller than wheat seeds. They are next year's leaf and branch and flower buds. They are rolled tight and wrapped in fur and spicy gums, to keep out the cold and water. In the first warm days, in February or March, these buds swell. If you break off some twigs of willow or lilac, and put them in a jar of water in a sunny window, you can watch them burst into green leaves and branches and flower buds.

Like the squirrel, the plant stores its food for winter, and it pops out of its hole and goes to work again, just as soon as earth and air and sunshine say:

"Wake up, children, spring is here."

And some trees, like the willow, alder and poplar, even whisk their saucy little catkin tails in the air, just like squirrels.

IX. PLANTS HAVE VISITORS AND TRAVEL ABROAD

What a great thing it is for little boys and girls to have play mates. How many more things you learn to know and to do, and how much better a time you have, if you play with others. It is best of all to have some one who has lived in a very different place, and in a very different way from yourself, to play with.

Do you live in the country? And have you some little cousins who live in a city? Very likely they visit you in the summer. What a treat it is to them. A farm is a strange, delightful land to a city boy. How many wonders he sees, and how eager you are to explain them to him. Then you go to the city to visit, and you see enough new things to talk about for weeks. It is a good thing to go away from home, and to have visitors. Moving about and mixing with people brightens us all wonderfully, and makes us change some of our ways of thinking and living.

It is just the same with plants. Plants that live by themselves, and do everything for themselves, are like hermits in caves. The liver-worts, mosses and ferns are sort of hermit plants. Palms and pines and grasses travel a little. Their pollen grains take journeys on the wind, and visit other plants. They begin to change then. There are thousands of varieties of the higher plants.

As plants cannot run about to make new acquaintances, like little boys and girls, they need messenger boys to carry letters. They use the wind, the bees, the butterflies and the birds. By these winged messengers they exchange gifts with their friends and neighbors and relatives in distant fields, just as we exchange gifts at Christmas. Let us see just how they do it.

You have often noticed the grains of yellow powder on little upright threads in the hearts of flowers, haven't you? They are very plain in roses, in the blossoms of fruit trees and buttercups, and many common flowers. Perhaps some one has brushed a buttercup under your chin to see if you like butter. If you do that yellow dust rubs off on your chin. It is so loosely fastened, in some flowers, that you can blow it off. That yellow dust is pollen. Pollen is one of the things the plant needs to make seed. The other thing is an egg.

DO PLANTS HAVE "FEELINGS" TOO?



YOU know how your legs kick when someone tickles your feet. So all living things, including plants, respond to touch, but some, like the sensitive plant, show their "feelings" more than others. Chloroform has the same effect on plants it has on people—after taking it they stop "showing their feelings." Some plants get food by closing their leaves on insects that touch them. In the circle is a leaf of a big pitcher plant that grows in California and catches insects in its pitchers. Notice the flange that guides the insect into the pitcher.



This man is chloroforming a sensitive plant. On the left is the Trumpet Leaf—a plant that catches ants—and on the right the Huntsman's Cup, that "eats" cockroaches.



The Venus fly trap has leaves like jaws that snap up insects touching them. On the right is another kind of pitcher plant. The picture shows how its pitchers full of sweetened water are kept open to attract insects. (See SENSITIVE PLANTS AND CARNIVOROUS PLANTS.)

Do you remember the little balls and whip lashes in liver-worts, and the way in which the whip thrashed about in its bath cup and jumped to the ball? By the time plants grew into pines and palms and grasses, the whip lash turned to pollen grains, but the little ball remained much the same. It became an egg, packed away with others in a seed-case.

The egg always lies quietly in its case. Cut a ripe apple across the middle and see what a nice seed case it has. The egg has to stay where it is formed, and wait for the pollen to come to it. In the apple blossom there is a circle of pink petals. Those petals are not the flower at all. They are only the party dress the flower puts on for company. The real flower is in the center of the pink petals. In the very middle is a tiny white column, that swells out at the top into a spongy, moist button like a little dog's wet nose. This button often glistens as if it had a dew-drop on it. The column goes down to a knob hidden in a green cup, below the pink petals, and swelling out from the stem. In this knob are the eggs in a nest. By and by the pink petals will fall off, and the green knob will swell and grow and ripen into a juicy apple.

That is, it will do so if something happens in blossom time. The little column that rises from the seed case, and that has a spongy wet button on the tip, is hollow. It has a fairy tunnel in it. All around the column is a ring-around-a-rosy of little white hairs, with the yellow pollen grains on them. Those grains are so loosely set that a baby breeze fluttering the pink petals against them, or a blundering bee or butterfly in search of honey, brushes them off. Some of the pollen is sure to be brushed onto that little button in the middle when—down they go! The yellow dust sends a tiny rootlet on a toboggan slide down that tunnel, right into the eggs. When the two unite, they form a seed.

If that was all there was to it, it would be very simple. Every plant could make its own seeds, and wouldn't need any neighbors or relations to help it. But sometimes flowers have the eggs but no pollen. You can find a great many strawberry blossoms with the little button-topped column, but no yellow food for the eggs at the bottom of the tunnel. These imperfect flowers must always be planted among perfect flowered kinds of strawberries.

And sometimes, even when flowers have both of the seed making materials, they cannot unite them. The egg wants pollen from some other plant. It doesn't want the help of its brother in making seed,

but of its cousin. A Bartlett pear wants pollen from another variety of pear altogether. Fruit growers know this and plant different kinds of pear trees in an orchard. If not too distant, the pollen will find the eggs that need it.

So, in blossom time, there is a great deal of blowing about and visiting and exchanging of gifts between flowers. They seem to be amusing themselves; tossing their pretty locks, swinging their silken petticoats in the breeze, and gossiping with bees and butterflies about what is going on in neighboring fields and orchards. One can fancy a little sugar pear tree saying to a bumble bee: "Put some of my nice yellow pollen on your legs and take it over to Mrs. Bartlett, with my compliments. I'm sure it's what she needs for her little seed babies. Just press the button and she'll do the rest."



CORN PLANT

From the tassels at the top of the stalk the pollen falls on the silk at the end of the ears which are sprouting below.

Isn't that friendly? The plant world is very busy and helpful when it seems to be playing. The tall, plummy tassels at the tops of corn stalks, swing much as you do under the maple tree. But those tassels are so loaded with pollen that you can often see a brown dust hovering over a corn field. As the wind blows the tassels, the pollen is shaken down in clouds. It falls on the corn silks below. Each one of those silks goes back to little eggs on the baby cob. A pollen grain must fall on the hollow tip of each silk, and slide a hair root down the long tube to the egg, or there would be no kernels, or seeds, on the ear of corn.

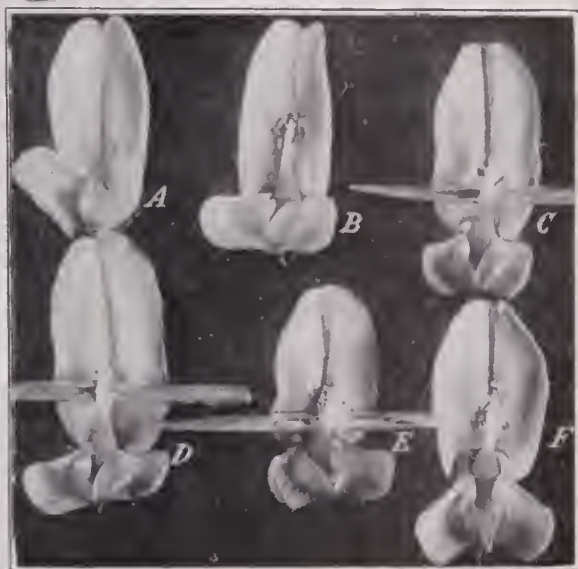
The wind is the only messenger of the pines and palms, the grasses and grains, and many of the straight-veined plants. The lilies and other bulb plants of the straight-veined family, have bee and insect visitors. Nearly all of the net-veined plants have such sweet blossoms and fruits that bees and butterflies visit them. When fruits and seeds are ripe the winds blow them abroad, the birds eat them, fly far away, north and south, sometimes hundreds of miles, and plant the seeds in other countries. In this way plants were scattered long before men began to grow them for food. The soil and rain and sunshine were not always the same, so plants had to change. Many varieties of palms and pines, grasses and wild fruits were made. The plants that traveled and had the greatest number of visitors, changed the most.

WHY "JACK" GETS HIS FACE WASHED

WHEN a bee pokes her nose into an alfalfa blossom she trips the stamen, which jumps up like a jack-in-the-box and scatters pollen on her breast; this she rubs against the sticky end of the pistil of this and other alfalfa blossoms and so fertilizes them. To produce new



varieties, Uncle Sam's experts do this tripping with a pin and wash off the pollen with a rubber bulb such as dentists use, so the flower cannot fertilize itself. Then pollen is applied from the flower of the plant with which the crossing is to be made.



A and B, before and after tripping; C, held by pin; D, after washing; E, after pollination; F, pin removed. Picture No. 2 shows how the sweet pea (A) is crossed by the removal of stamens (BC); D, after fertilizing; E, second morning; F, third morning.



Lettuce flower pollen can be removed with a small rubber tube attached to the garden hose. Such flowers as the single rose are easily crossed by the water method or by removing stamens (Sta.) and applying pollen to the pistil (P).

X. HOW PLANTS ARE PROMOTED TO A HIGHER CLASS

A long time ago people thought that flowers were given their beautiful colors and perfumes just to make the world a pleasanter place for people to live in. But now we know that everything lives for itself. It lives to eat and grow and make seeds of its own kind. No doubt, flowers have found out that men and women and little girls and boys are very good friends in helping them grow. They want all the help they can get, so they put on pretty dresses, and use perfumes to coax bees and butterflies to visit them, and they offer cups of honey to their little brothers of the air, so they will come back again.

When we see a flower it seems to have got so far away from the little cell full of protoplasm, or magic jelly, that we cannot understand that they can be made of the same things at all. But the little cell has the same power that the most beautiful flower has. It can take lifeless matter out of the air and water, and make living things out of it. And it can change. Lifted into the sunlight some of its cells turned green. Thrown out on the land, the cells clung and spread into a leaf and sent down rootlets. As the cells could no longer break away and float to start new families, it grew spores and used the wind to scatter them.

Plants changed first by dividing the cells, then by budding new ones, then by uniting different kinds of cells to make spores. In doing these things it learned to break up air and water and put them together in new ways. It learned to divide the work of the plant by making organs—roots, stems, leaves, blossoms, fruits. The lowest plant is a cell, but the highest is only a multitude of cells made of the one material—protoplasm, but changed into many forms and given many kinds of work to do. From using water alone to float in, the plant learned to use earth, air, wind, insects, birds and men, to help it make and scatter its seeds, and to grow better plants.

When you go into the fields and woods in the spring to gather wild flowers, haven't you found some blossoms larger, more perfectly colored and with a sweeter perfume than others? No two violets are just alike. Some are small and pale, others large and blue and fragrant. In the plant world it has always been like that. And the stronger plants always have the best chance to live. They have

better soil, or more room to grow in, or more sunshine or, something that makes them better than their brothers and sisters. So they have a chance to make better seeds. The weak plants die more easily. This is nature's way of picking out the best.

Among the flowers there were some born with deeper little pockets, so the insects could not get at the honey without covering themselves with pollen. So these flowers kept more of their honey for their own use, and made the bees and butterflies scatter their pollen. The kind of flowers that spread their honey, or that had pockets that were easily "picked," died. The flowers that have the stronger perfume have a better chance, too, and those that have attractive colors.

Suppose a bee goes after honey in an apple blossom. It likes the color and the smell. So it goes to another apple blossom and another. It doesn't visit anything but apple blossoms until it goes back to the hive. Just why it does this we do not know, but very likely bees and butterflies are much like little boys and girls. When they get a taste of anything good, they like to make a meal of it. Once a little girl was asked why she didn't eat bread with her jelly. She thought a moment and then said, soberly:

"The delly is dooder."

Maybe that is all the answer the bee could make. For the time it has the color and smell and taste of apple blossoms, and that seems "dooder." The next time it comes it may blunder into a head of clover. Then nothing but clover will satisfy it. In this way insects are kept from mixing the pollens of different plants. The traps and tricks that flowers have learned, to make the insects scatter their pollen, is interesting. Some have hair nets over the honey cups to hold the little visitor until, in his struggles, he rubs the pollen from his legs, onto the little wet buttons on the seed tube. Then they give him a little honey and let him fly away.

You didn't know, perhaps, that some flowers are so much better than others of the same kind that they really are a little different. You know it is like that in human families. Lincoln was better than and different from all his own people and his neighbors. So was the poet Shakspeare, and the poet Burns, and Daniel Webster and Washington. Men who have studied plants find some with a genius for going up higher.

One day a man like this was walking in a field of yellow poppies, in California. Yellow poppies grow wild there. There were acres and

acres of these poppies, as yellow as gold. Suddenly he saw one blossom that had red stripes on its petals. He tied a label on the stalk so he could find it again, and left it there for the seed to ripen. He gathered these seed and planted them in his garden near some red poppies. When the two blossomed he took the pollen from the red poppy on a camel's hair artist's brush and, as lightly as a butterfly, put it on the seed button of the striped blossom. The seed from that, the next year, grew into big, crimson flowers.

The name of this plant wizard is Mr. Luther Burbank. He has made big, snow-white, double-petaled Shasta daisies from the common field daisy. He has grown white blackberries, and stoneless plums, and thornless cactus that cattle can feed on in the desert, and many other plants. If you ask him how he does it he will say, modestly, that he finds a plant that wants to come up higher, and he helps it a little, just as a rich man or a church will sometimes send a very bright, ambitious boy to college.

Farmers help plants come up higher, and get better and different varieties of seeds all the time. They plant the largest seeds from the biggest, fullest ears of corn, and the best filled stalks of wheat. They take the smoothest, mealiest potatoes with the healthiest eyes. And they change the crops grown on a field. Wheat and cotton and certain other crops use up the plant food in the soil, if they are grown year after year in the same fields. So clover is planted to make nitrates for the soil. Flowers really do want us to look at them and smell them, just as they want the wind to blow on them, the bees and butterflies to visit them, and men and birds to eat their fruits. If we love them and find them useful to us, we help them grow and change.

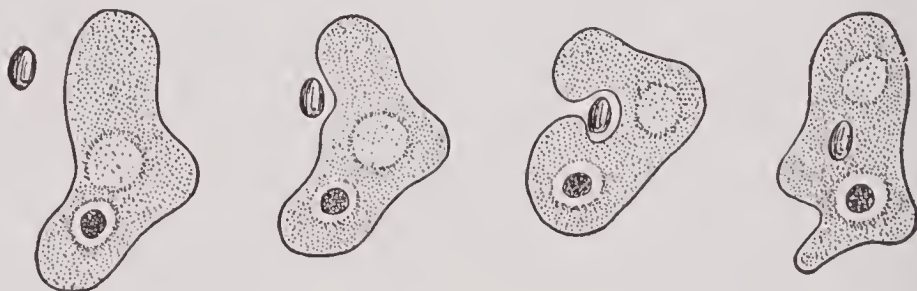
The old, old call of "come up higher" is still sounded in the woods and fields. Older people can remember the first navel oranges without seeds, and the big Burbank potatoes. Every flower show has some new and more beautiful rose or chrysanthemum; every new spring seed catalogue its new colorings of sweet peas and nasturtiums. Any little boy or girl with a tiny garden, can watch for some flower with a poet's gift for size, color or perfume, and help it "come up higher."

PART II—ANIMALS

I. THE LITTLE ANIMAL THAT WALKS WITH ITS STOMACH AND EATS WITH ITS FEET

Don't you like the menagerie part of the circus best? And the "Zoo" in the city park? Wild animals are so strange and interesting. In every pond and creek there are animals that are just as strange. You don't have to buy a ticket to see them, as you do for a circus. But you can see a great many more of them, and all of them a great deal better, if you have a good microscope. Some of these little animals are wonderfully small, as well as wonderfully made.

The lowest forms of animal life, as of vegetable life, live in the water. The very, very smallest animal is just a single cell, too small for you to see without a magnifying glass. The yeast plant, you



AN AMOEBA FEEDING

In first figure a bit of food lies near it, in second figure it draws near the food, next it stretches around it and then it swallows it.



The first figure shows how the amoeba changes into a solid mass if touched, and the last two figures show the amoeba dividing so as to make two.

know, is alike all over, and gets its food by "soaking it in through its skin."

One of these single-celled animals is called the amoeba. That is a Greek word that means "change." The amoeba can change its shape whenever it wants to. If you could put on a pair of wings as easily as the amoeba can make feet, you could do what every boy has wanted to do—fly like a bird. Whenever the amoeba wants to move in a certain direction, little legs push out from that side of its body and draw the rest of the amoeba after it. Whenever it wants to go in another direction it draws in these legs and makes legs on the other side.

But when it wants to eat it doesn't make a mouth, and put food in this mouth, as you might suppose. Whenever it touches the food on which it lives, it simply wraps itself around it like a little boy trying to carry a big watermelon.

It looked very odd to see the hair-like growths of the flower cup close around the bee and make it give up as much of the pollen on its legs as the plant wants, before letting go. It looked as if even flowers could think sometimes. So the little amoeba acts as if it could think, too. It seems to have ideas and tastes just as we have. Not so many ideas, and not so many tastes; but you would hardly expect that of an amoeba, would you? An amoeba is thousands and thousands of times smaller than we are—hardly a hundredth of an inch across its little body. Just think what might happen, if we were as many times brighter than an amoeba as we are times larger!

For see what it does:

If it wraps itself around a piece of food that is too big for it—if it "finds its eyes are bigger than its stomach" as little boys do sometimes—it just unwraps itself from the food and glides away. Sometimes it seems not to like the taste of things, for, having wrapped itself around something, it holds it awhile and then lets go of it again without eating it. Some of the little animals it eats have shells. When it is through with one of these it unwraps itself and drops the shell.

And it seems to have nerves, too. Of course we can't tickle its feet because it hasn't any except those that it makes when it wants to go walking. But if you touch it, or shake it, it pulls all of itself in, making itself into a little round drop of jelly.

You have often noticed how an earth-worm, or fishing-worm, as you call it, will shrink when you touch it. This shows that the earth-worm has "feelings," too. It has something that answers

for nerves. We couldn't get along very well without nerves because it is through them that we know what is going on around us. Nerves are just as necessary to make things go right inside of us. It is by means of the nerves of the eye that we see, the nerves of the ear that we hear, the nerves of the tongue that we taste.

As the cells of plants change into roots or leaves or bark, when leaves or roots or bark are needed, so all the different parts of animals, from the amoeba up to man, have been made to grow by the work they have to do. The amoeba uses all parts of itself for the same purposes. There is no part that always does the walking—so it has no legs or feet. The legs and feet which the amoeba makes, as it wants them, are called "false feet." It has no stomach that always stays a stomach, because there is no part that it always uses to digest its food.

There is a little animal called the "moneron" which is still lower in the scale of life than the amoeba. For one thing it hasn't any skin—this moneron. Inside and outside it is just the same. The amoeba has a kind of a skin on the outside, and a little hollow place on the inside, which serves both as a heart and lungs, distributing the food and oxygen from the water throughout its body. The oxygen which it needs comes out of the air just as does the oxygen which we need. You know there is air in the water.

Next above the amoeba are little animals called in-fu-sor'ia. These, under the microscope, look like caps or bells, with little hairs all around them. They remind us of the little whips that help to make the spores in the liver-wort, as if to say that plants and animals are related. These infusoria go thrashing around in the water just as the whip-tailed cells of the liver-wort do, using the hairs to swim with, just as the liver-wort cells uses these whips. These little hairs *stay* little hairs, and are not drawn back and changed into something else, as are the feet of the amoeba.

Still higher up are other little animals that look something like these, but in addition to having these little hairs to swim with, they have mouths that stay mouths all the time. In these little animals part of the hairs are used like oars to swim with, and those around the mouth are used as hands, fanning other little animals into the mouth.

Now don't you believe that, in a pool of standing water, there are just as wonderful animals as in a circus? And don't you see, also, that in the animal kingdom, nature begins spelling out her

wonderful story, in little easy words of one syllable, just as you learned to read when you began with the primer:

"It is a c-a-t."

Only, when we read the Book of Nature we can't begin with the cat; she's away up in a higher grade, with the fish and the birds and boys and girls. *She* has a backbone; and these little animals in the pond menagerie haven't any bones at all!

Your big brother or sister who goes to high school, can tell you more about the amoeba and other simple forms of life. Or, if you have a very fine microscope, he can show them to you. You may find amoeba on the dead leaves in the bottom of pools, or in the home or school aquarium, or on the roots of duck weed and other small water plants. You can also put some hay or straw in a glass jar filled with water, let it stand a few days in a warm room, and get specimens of another kind of one-celled animals. Then you can watch them through the microscope. See AMOEBA, page 64; BIOLOGY, page 212; PROTOPLASM, page 1554; PROTOZOA, page 1554; INFUSORIA, page 925.

II. WATER BABIES THAT LIVE IN A VILLAGE

If the amoeba is ever to get up in the world very far, it must stop using all its parts for everything. The first little creature to make a stomach on the inside, you know very well. Or, rather, you know his empty house. A sponge is the skeleton, or bony house, where hundreds and hundreds of little animals once lived. They all live together so they can help float food to each other's mouths. You know a sponge is full of holes. These holes are long, crooked water streets of the bony town. Other sponge colonies live in glass towns. Those are very beautiful.

Bath sponges are a kind of elastic horn. Elastic means that it will stretch, like rubber. When you fill a sponge with water and squeeze it out, you make it do over again, in a way, what it does when every room in it has living baby tenants. The sponge lives by having water flow through its village. But, instead of soaking up the water and squeezing it out, the water is paddled through the little streets, by little hair-like arms.

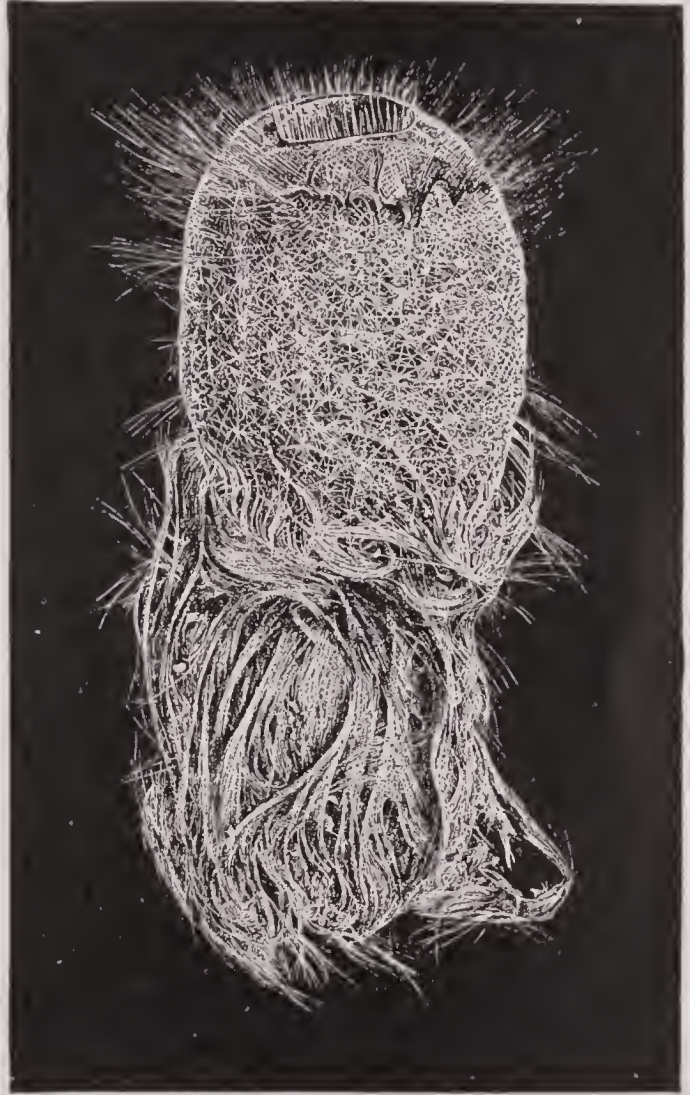
The sponge is the lowest animal that is made of more than one cell. The sponge has a stomach on the inside and bones on the outside. By living, a great many of them, in one house or village, like those old cliff-dwellers, all the little sponges get along better. They live very close neighbors, all work for each other, buy their food of the same grocer, and pay for it in a lump. Their house is a kind of fort, too. Larger water animals could "gobble up" millions of separate little sponges, but a whole village of them, in a horny house, is too big and tough a bite. It's a great thing to be sociable, to make friends and live in peace with neighbors. That makes life easier and pleasanter for boys and girls, bees and sponges.

The holes in the sponge are little mouths that lead into the village. Inside of it, when the sponge is alive, there are little one-room houses, and in these are packed, side by side, little jelly-like cells with tails. These tails stick out into the water and, like little fishermen, catch smaller plants and animals out of the water, as it passes through the sponge. At the same time these tails, or fishing poles, catch the water as it flows through the channels. The water also carries air, and the sponge gets its oxygen out of it. You see, the sponge like the fish, must breathe under water.

While the sponge is like an animal, in eating other little animals and plants, it is like a vegetable in that it cannot move around. It is rooted to one spot. The sponges grow so thickly that they often make perfect forests on the rocks, on the bottom of the sea. When the sponge is taken from the water it is covered with what seems to be a mass of jelly. This is its flesh, and the flesh is made up of the little cells with tails that I have been telling you about.

Just as if you might forget—although it seems so plain—that this sponge is made up of little creatures like the infusoria, and has become a higher order of animal because all these little animals formed into a society and worked together, the sponges increase by laying eggs; one-celled eggs. These eggs first turn into simple little animals with paddles all around them, like the infusoria, and they swim around by themselves, for awhile, before a number of them settle down together to form a sponge. They are like boys that go out into the world awhile to learn what it is like, and then join other boys and go into business together.

As we go along you will find nature continually “saying her piece” over again, from the beginning, as if to be sure she gets it right. And, also, I think, she may do it to be sure that we catch the idea of what wonderful things all of us can do in this world, if we will do each little thing, build each little thing, as well as we can, and keep looking upward as we build.



A sponge as it appears attached to the ocean bed. The little animals inside the horny skeleton stick hairly-like tails out into the water to catch their food.

It is as if nature said, after studying the yeast plant: "This yeast plant will make something better if it can get out into the world." So she took the same sort of little cells out where they could meet the air and the sun, and there came the liver-wort, part leaf and part root, and the first plant to find out how to make spores. Next came the mosses which began to stand up; and then the ferns which gave the vegetable world its backbone. Last of all came the flower-bearing plants, and with it the great partnership between the animal and the vegetable world, each helping the other to live.

But to do all her wonderful work Nature, like you and me, had to work with two hands. While with one hand she was helping the vegetables to get up high enough to receive the help of the animal world, in getting still higher; she had to teach the amoeba how to grow into birds and butterflies and men, so that they could come into this grand plan of things, and make more and more beautiful and useful varieties of animal and vegetable life.

Now, her work with her right hand, in growing the wonderful varieties of animals from the shapeless, formless amoeba, has got along as far as the sponges, which already have mouths and "hands" and the beginnings of bones, and a hollow inside.

Not only have sponges so many more useful and interesting parts than the amoeba, but they show, again, how fast you can make differences when you have more than one part to multiply with. Sponges have many different shapes, different colors, and they live in many different kinds of places. One kind of sponge is called the finger sponge, because it has fingers like the human hand. Another is shaped like a banana. Others are almost as round as a ball. Some look like a flat red mat, spread over the rocks under the water, as if for the entrance to the doorway to some palace of the water fairies. Some are black, some yellow, some brown.

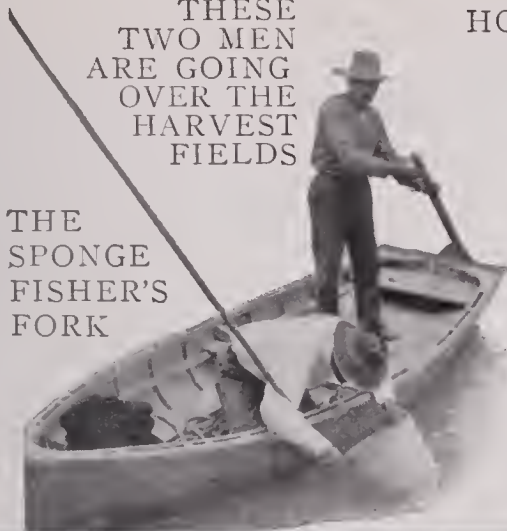
One kind of sponge looks like a beautiful vase of spun glass, and when these sponges were first brought to Europe, from their home in the South Pacific, they were not thought to be sponges at all, but vases made by very skillful workers in glass. They were known as "Venus' Flower Baskets."

The sponge itself is not only made up of other little animals living together, and getting food for one another, but other animals, of a higher order, are often found living in the cosy sponge village. In the larger sponges are found shrimps, crabs and even fishes. See SPONGES, page 1801.

FARMING UNDER THE SEA

THESE
TWO MEN
ARE GOING
OVER THE
HARVEST
FIELDS

THE
SPONGE
FISHER'S
FORK

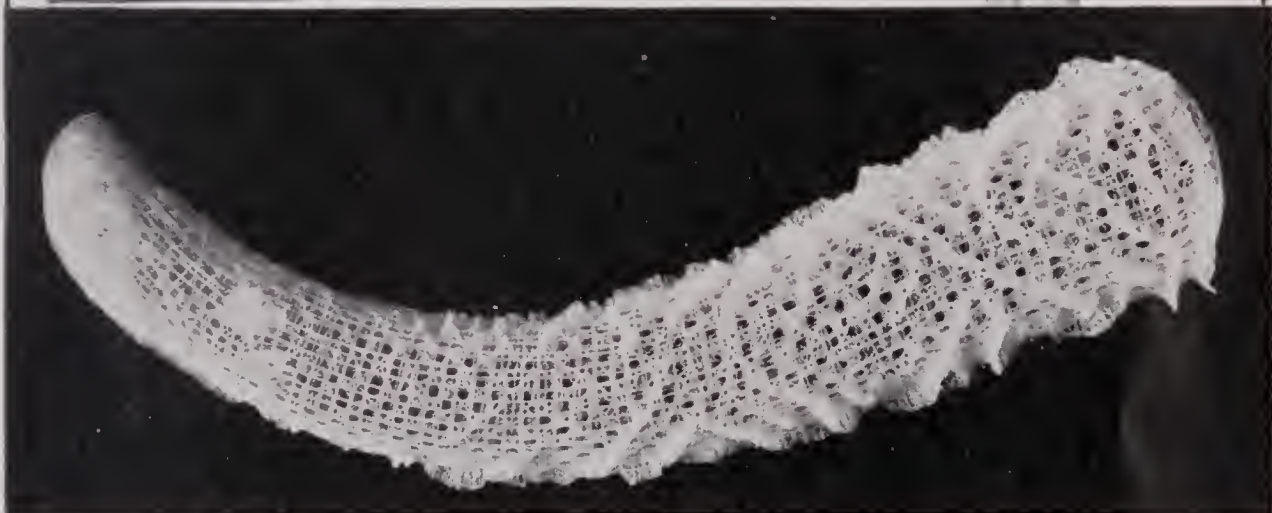


HOW THE SPONGE CROP IS HARVESTED

"When the vessel reaches the grounds, the men go out in pairs in row boats, one man leaning over and scanning the sea bottom with a water glass. When a sponge is seen, it is secured with a kind of steel fork on a long slender pole."—*The New Student's Reference Work.*



THE
SPONGE
FARMER



DO YOU WONDER IT WAS MISTAKEN FOR SPUN GLASS?

"One kind of sponge looks like a beautiful vase of spun glass. When first brought to Europe they were not thought to be sponges at all, but vases made by very skillful workers in glass."

FROM SEA BOTTOM

Below, on the left, a Greek sponge gatherer is going down in a diving suit off the Florida coast. After being gathered, sponges are put into those wicker



TO THE MARKET

pens where the tide washes them, but cannot wash them away. Below, to the right, is a sponge market where the sponges are graded and offered for sale.



III. A SEA FLOWER THAT EATS WITH ITS PETALS AND MOVES WHEN IT WANTS TO

The sponge, the jelly fish and the coral builder are hollow-bodied animals. They are higher than the amoeba because they have more different parts. The locomotive is a higher order of machine for moving things than baby brother's go-cart. So, the sea-anemone is higher than the sponge. It is very puzzling, but you like to study puzzles and find the answers, don't you?

Here's puzzle number one: Does the sea-anemone look most like an animal or a vegetable? You will see from the picture that the answer is very easy. But—

Why does it look so much like a vegetable? Well, why do your own lungs, that you breathe with, look like a vegetable?

Your lungs are shaped a good deal like a tree with trunk, limbs and branches; and, we might almost say, twigs and leaves. The lungs are spread out in this way to get the oxygen from the air that you breathe. The lungs digest air as your stomach digests its food. Because the air is not so solid as the food your stomach digests, it takes a good deal more of it for the lungs to get the amount of oxygen you need. So they are spread out to catch as much of this oxygen as possible every time you breathe. Leaves are the lungs of the plant. There must be a great many of them, and they must spread out to take in enough air and sunshine.

If you lived in the water all the time, as the sea-anemone does, and had to get oxygen out of the water, and had no special place inside of you in which to keep your lungs, you would have to be spread out as the anemone is, into as many branches as possible, and do all of your breathing through your skin. Then—if you were a sea-anemone—you would eat as it does. The way in which the anemone eats is something like the way in which the amoeba eats but yet is quite an improvement.

The anemone lies all spread out like a flower, until a fish or some other of the little animals, upon which it lives, comes swimming along. As soon as it touches the arms of the sea-anemone, which look like the petals of a flower, these "petals" close around it, just as your fingers close around an apple. They gather in the food and push it into the anemone's mouth. Then the anemone wraps its whole self around its food and shrinks up so that it looks like a

teacup turned upside down. It keeps to this shape until the food is digested. The anemone's stomach is in the center of its body, but it seems to take the whole inside of the anemone to digest its food, just as it does with the little amoeba.

The anemone's stomach is one of the queerest things you ever saw. It is surrounded by little rooms that are connected with each other by two openings that we might call "windows." Each of these rooms is also connected with the stomach in the middle, and with those parts which, as you see, look like the petals of a flower, when the anemone is spread out, waiting for its food. Each of these "petals" is hollow like the fingers of a glove. The anemone not only lives surrounded by water on the outside, but it is full of water on the inside. Water is to the anemone what blood is to you; it circulates all through the anemone, and the anemone makes its petal-like fingers stand up by filling them with water. These fingers are called tentacles. When the little animals on which the anemone lives, touch one of these tentacles, the anemone forces a large part of the water out of itself, shrinks up around its food and becomes a little upside down cup of an animal, with thin walls.

The sea-anemone not only looks like the flower of that name, but it has something that reminds us of the vine called the Virginia Creeper. The anemone is fastened to a rock by a sucking disc. It holds on with this sucker a great deal tighter than the vine clings to a wall it is climbing, with its little sucker feet. If you try to pull a sea-anemone up, you might think it has a strong root running down into the rock. But it has only a sucker foot for clinging. Sea-anemones have been known to move, but as a rule they spend their lives contentedly, fastened to rocks near which they are born.

This use of a sucker foot by the sea-anemone and the vine, is one of the many cases in which nature gets hold of a good idea and uses it over and over again. And she uses the sucker foot for plants and animals just as she uses the seed or egg for ferns and fishes, butternuts and butterflies. She gave the sea-anemone a sucker foot because he can get along best by clinging to a rock, and she gave the vine sucker feet to climb rocks and trees with. When the sucker foot idea once got into the two families of living things, Mother Nature seemed to say:

"Now all of you children who can use it, may have this little sucker foot."



A GROUP OF SEA ANEMONES

The oyster and the clam both have a sucker foot. The oyster uscs his to fasten himself to something, as the ancmone does, and stays there. But the clam uses his foot for travelling. So, the oyster, lying in one position, gets a shell that looks lop-sided, but the clam's shell has both valves alike. People who live by themselves, in one place, get one-sided, too. Instead of saying "don't be a clam" we ought to say, "don't be an oyster." The clam is well-balanced. A man is well-balanced who can see both sides of a question.

My! My! Here we have wandered away from the sea-anemone looking at vines, clams and oysters, seeds and travelling minds, and almost have forgotten our little sea-anemone! But here he is sticking patiently to his rock. Perhaps he has other things to tell us.

"Yes, indeed," he says. "When you were speaking of sucker-feet you didn't mention the fact that I had them long before there were sucker mouths. And how would human and some other animal babies get along without those, I'd like to know. You smack your lips over something good, don't you? And you pucker it to kiss with, too. I taught you how. I pucker my sucker foot to cling with."

"And I taught birds to lay eggs. Well, I'm ready to admit that the sponge taught me."

Anemones, like the sponges, make eggs, or seed babies. These eggs hatch into odd little animals that, for awhile, swim about in the water. They finally settle down on a rock, and grow into these beautiful flower-like animals that are found in the gardens under the great waters of the world. You can see that the anemone, which is so much higher a type than the sponge, at the same time repeats the habits of the sponge in first being a free, swimming animal, and then settling down in one spot. The anemone, however, can move about a little while, but the sponge cannot. After it once settles down the sponge must stay there for life. The ancmone can move only a few inches a day; so I suppose it says, "Oh what's the use," and generally it stays in one place.

But, low down as it is in the scale of life, like the jelly fish, the anemone has learned how to move. So, it begins to foretell the wonderful animals that are coming, that can swim in the water, fly in the air, and finally run about on the land. And that's foretelling little boys and girls, you know.

My! But wasn't it a tre-*mend*-ous thing for a little sea-anemone to let go of the rock and move, if ever so little a way? See SEA-ANEMONE, page 1712.

IV. THE WEB OF LIFE: MOTHER NATURE AT HER LOOM

Big boys and girls, when they finish high-school, have to write graduation essays. One of the subjects they often choose to write about is "The Web of Life is Strangely Woven." They like to tell how life is made up of different things, all woven together: Joy and sorrow, health and sickness, work and play are woven in and out into one web. They see the poetry and the prose of living, loving, working, enjoying.

The writer of this had been out of school a long, long time before he learned that his own body was just such a wonderful web. A living body, of a plant or an animal, is a web. It is made up of single cells, multiplied and woven together. Mother Nature uses the same kind of cells, put together in different ways, to make leaf, stem, bark, flower and fruit, in the tree. So she makes skin-tissue, bone-tissue, muscle-tissue, nerve-tissue in the animal.

It took Mother Nature ages and ages, sitting at her loom, experimenting, to learn to make these different tissues out of one material. In the amoeba she had only a very thin skin and a jelly-like muscle. In the sponge she made a horny bone. In the earthworm she made the first ring muscle.

If you get up very close to Mother Nature, as she sits at her loom, you can watch how she works. Her shuttle has a back and forth movement, through the long web of lives. First, she made a plant cell that couldn't move, then an animal that could. Then she made the sponge, an animal that was fastened to a rock, like a deep-sea lichen; then a sea-anemone that could let go of the rock. The amoeba hasn't any bones, the sponge has, the jelly-fish hasn't, the star-fish has. Now bones are very important. Why, when Mother Nature learned to make them for sponges, did she drop the idea, and then come back to it afterwards?

Let us see if we can find out. We will also see Mother Nature weaving lower forms of life into the higher. What looks more different than Johnny with his fishing pole, and the earthworm he uses for bait? Yet there are many things about that earthworm that are just like things in Johnny. The earthworm's body is made up of ring muscles. Those are the very first hints of the ring-joints in Johnny's backbone. Those ring muscles are what makes it possible

for the earthworm to turn and twist and move forward and to shrink.

Yet, in making those ring muscles for the earthworm, Mother Nature's shuttle shot back across the web. She dropped the bones she made for the sponge and star-fish. One thing at a time, she says. I'll go back for those bones, when I get ready to put the earthworm into a shell. The crawfish is only a worm in a shell. The spider, the ant, the bee and the fly are all ring-jointed, but have no shell. When she got up to insects, Mother Nature dropped the bone or shell idea, to make better brains and senses. The bee, the ant, and the spider have such large brains, in proportion to their bodies, that they are a wonder to men.

Having made brains and sensitive nerves, Mother Nature began to use bones again. But when she made ring bones along the back of the fish, she dropped behind in brain power. A fish isn't nearly as bright as an insect. A reptile is a little brighter than a fish, a bird—you know how "smart" a crow is? By and by, Mother Nature made little boys and girls who can read, and understand this story of life.

It is very important to have a backbone, something to stand up with. You saw that in the great world of plants, when the simple yeast cell was slowly changed into the noble forest trees. All animals with a backbone are put into one class, called vertebrates. Those without backbones are called invertebrates.

Man is the most wonderful of all the animals, but even he isn't as clever in everything as are many of his humble relatives. He cannot swim like the fish, nor fly like the bird. That is he cannot do these things at first. But he has brains to "think out" things. Then he can build ships and flying machines.

When he first comes into the world, man is the most helpless of all animals, and he remains helpless the longest. But that is an improvement. It was a great thing in the history of life when animals began to think about their babies, and about taking care of them. Little insects born as creeping larva, are able to take care of themselves as soon as they come out of the cocoon. But they never get very far, and they soon die. It is only when animals begin to spend a part of their lives learning things of their mamas—as spiders and ants and bees and birds do—that they amount to much.

The children of savage men—such as Indians—live longer with their parents and depend upon them more than do the animals, and so they learn still more. White children spend still more of their

time at home, and at a great place called school, which gives all of its time to carrying on the work that is begun in the home.

In both home and school the greatest thing of all that a boy or girl learns, is to love and to help other people. So far as his body is concerned, a boy doesn't differ so very much from animals lower than himself. He differs most of all in his power to reason, and to think and to care for the happiness of others. He has a sense of right and wrong, of honor, of justice, of unselfishness, of fair play, of pity. These are the social and moral powers that, alone, make human beings far above all the other animals.

But these fine feelings, too, began far back with the first animals that cared for their babies. Long before Mother Nature got up to human beings, she made ants and bees live and work in colonies, and birds care tenderly for their nestlings.

What, do you suppose, was the very first animal that carried her helpless babies about with her, and fed them in some strange way?

V. STARFISH, AND SEA URCHINS THAT PLAY WITH LIVE DOLLS

Animals like the sponge and the sea-anemone rank higher in the scale of life than the amoeba because they are hollow-bodied. The next higher step is taken by the group of animals to which the starfish, the sea urchin and the sea cucumber belong. They may be said to have real stomachs. The sponge and the anemone only have a special place in the body set apart for digesting food.

Of course there are many strange and interesting things about these animals as there are about everything in the great book of nature, when you come to look at it closely. Probably the amoeba doesn't have as much trouble with his stomach as you do sometimes when you eat more than you should; for if the part of himself he happens to use for a stomach today gets out of order, he can use the other side of himself for a stomach tomorrow, and so give today's stomach a rest. That is the best thing a boy can do for his stomach when it gets out of order. Give it a rest. But the sea cucumber can throw away its stomach and grow a new one.

The starfish belong to the spiny-bodied group. They are higher than the sponges and animals of that class, not only in having stomachs more like ours, but in other ways. They are the first animals that begin to walk on solid ground. This they do by forcing water into the suckers with which they get their food. When the suckers are made firm and strong by being filled with water taken into the little animal's mouth, they are firm enough to walk with. (Don't you see how in the starfish, Nature is using over again the sucker foot of the anemone, and his water-filled "petals"?)

The starfish has nerves, as we have already learned. These animals are called starfish because a great many of them are shaped like five-pointed stars. The body is in the center, and the rays



SEA-CUCUMBER

A sea animal which seizes its food with the long tentacles seen at top of picture. Through these it breathes also. It moves by the tubes or feet seen on the body, which when filled with water act as suckers and drag the animal over the bottom.

correspond to our legs and arms. The nerves run along each ray. At the tip of each ray is a little dim eye, and a filmy covering that takes the place of an eyelid. Each ray is really a branch of the stomach. Little canals run from the stomach, which is in the center of the starfish's body, out to the end of each ray.

The starfish can move each ray separately, just as you can move each of your legs or each of your fingers. In this way the starfish is able to travel much faster than you would imagine.

Another member of the great hollow-bodied family, to which you, too, belong, is the sea urchin. In the water, these sea urchins look like round pin cushions stuck all over with black pins, with the *points* on the outside. When you find them on the sea beach, with all their spines gone, you think them a kind of sea shell. These "pins" are to protect the sea urchin against its enemies. They branch out in every direction like the bayonets of soldiers. That spine armor idea was so good, that Mother Nature used it for the porcupine, and for the thistle and the rose. The sea urchin uses these pins to walk with but, although they have between three and four thousand of these pin feet, they get along very slowly. Whenever we make a specialty of anything we can always do it better. It is when animals come to have two feet, as in the case of man or the ostrich—or four feet, as with squirrels—that they can run and climb trees and build houses and do other things that the sea urchin never even dreams of.

The sea urchin lays eggs, and from these eggs come the young urchins. (What other animal have we already found, that lays eggs?) When they are babies they don't look a bit like their parents. And here is another thing that the sea urchin does that you will remember when we come to kangaroos. Some of the sea urchins carry their babies in pouches. They fold their spines over their babies just as you carry a doll in your arms.

Do you remember, among the strange things that happened in "Alice in Wonderland", that there was a cat that faded and faded away, and left nothing but the grin? You have seen a great many cats without a grin, but a grin without the cat really seems improbable. But this—that I am going to tell you—has happened, not once but many times; no doubt millions of times:

An animal has faded away and left nothing but its mouth! This animal is called the *sympata*, and is a member of the sea cucumber family. Whenever this animal fails to get food for some time, it

seems to say to itself: "If I wasn't so big I wouldn't be so hungry;" so, to save expenses, it drops off a piece of its body. If it still cannot find enough to eat, it drops off another piece—and so on until there is nothing left but its mouth. Then, if it gets something to eat, it begins growing again, and so replaces all those parts of itself that it threw away. The spider and the lobster can grow new legs lost in a fight or accident.

That seems very strange until we remember that when we are ill, or for any other reason eat and digest less than we need, we lose flesh, too, though not all in one spot. Then, when we begin to get well we put it on again.

Perhaps our bodies wouldn't know how to do that if this queer little animal hadn't taught nature how! And perhaps we wouldn't have five fingers and five toes if the starfish hadn't counted five first; nor any eyes or nerves if he hadn't found them for us.

And, Mary, when you carry your doll baby in your arms, remember the sea urchin did it first!

Perhaps she taught you how.

Perhaps.

Who knows?

At any rate, there she is—Mrs. Sea Urchin, carrying her little urchins in her spiny arms!

VI. A LONG SPEECH BY A LITTLE WORM

All worms are of a higher order than the spiny-bodied animals such as the sea-urchin and the starfish. This is not exactly because some of them do such bright things as to build houses and hang front gates. It is because they are better made; and so, on the whole, are better fitted for their work in the world.

To be "better made," in the animal and vegetable world, means to have more parts, and each part fitted to do some special thing. The amoeba has no feet, no stomach—no anything, you might almost say. If it needs a foot it makes it. When it wants to eat, it wraps itself around its food and one side is as good as the other for this "made to order" stomach. When we get up to the sea cucumber we find a little animal that has lungs and nerves and a stomach. To be sure the sea cucumber throws away its stomach when it gets excited, and then grows a new one.

Now, when we come to the worms, we find still better machines for living. Take the worms you call "fish" worms. Their real name is earthworms, because they help to make the kind of earth in which plants grow best. You would be surprised to know in how many ways the earthworm is like you.

For one thing, he has a stomach; not a stomach like the amoeba, made and unmade all the time; nor like the sea cucumber to be thrown away whenever he gets peevish—but a *real* stomach that he keeps all the time, and uses for nothing else. His body, as you see, is a tube. Inside the tube is another tube. This inside tube is his stomach.

And he has blood, too. After the worm's food is digested it becomes blood, as our food does. He has the beginnings of hearts, also. I say hearts, because worms have several hearts. The earthworm, for instance, has five. They are simple little hearts that answer his purpose very well, but they wouldn't do for you at all. You must have one heart with several parts, instead of five simple hearts. Whenever Nature wants anything better done, you notice, she turns it over to one part that will give the whole of its mind to it.

The earthworm has one vein and one artery. Both are tubes like those that carry blood to and from your heart. One runs along his back, above his tube-like stomach. The other runs under his stomach. The five little hearts connect these two blood vessels,

like the rounds of a ladder, as you see from the picture. After the worm's food is digested into blood, it oozes out into the rest of his body. The different parts of the worm are bathed in it, and so are made to grow. Most of the earthworm's blood is used in this way; so only a part of it is passed back through the hearts. These hearts do not have so much to do as your heart does, and that is why they are so simple. In the next higher group of animals—those with a shell, like the crawfish—we will find the heart is not so simple.

You notice the earthworm is made up of sections or rings of muscles, just as your backbone is made up of rings of bone. So he not only hints at the heart and blood vessels of animals higher than himself, but he seems to say:

"See how useful it is to be made up of rings. See how I can bend and turn and twist and get in and out, everywhere. The animals below me cannot do this. After awhile there will come an animal with a backbone, made up of rings. He will crawl on the ground, and be called a serpent. Then will come other animals with stiffer backbones and feet. They will not have a great many hooklike feet as I have. They will have only four good, jointed feet. In the water, also, there will be animals with backbones. Instead of feet they will have paddles or fins. Into the air will come animals with backbones, two feet and two fins, called wings. With these wings they will swim the air.



An earthworm showing the sections or rings of muscle.

"Last of all will come the most wonderful animal of all. At first, when he is a baby, he will creep about on his little stomach, just as I do. Then he will go about on four legs for a while—will creep on his hands and feet. Then, when his backbone grows stronger, and he has learned to stand alone, as the fern learned to do long ago, he will begin to walk with two of his legs, and the other two legs, now called arms, will be set free to use in other ways.

"On these arms will be hands, and on these hands five fingers, like the five rays of the starfish and the five petals of a flower. With these five fingers he will grasp, first of all, his food, as the star fish does with his five rays. Then with these hands and fingers he will make boats to go about in the water like fish. At first he will make only play boats, then, as he grows older, big boats, with fins, called paddles. After awhile he will make other boats with paddles or wings for swimming in the air. These the will call flying machines.

So, although he cannot swim as well as the fish, nor fly at all, as the bird does, he can make swimming machines and flying machines and so turn into a fish or a bird whenever he likes; just as if he were part of a fairy tale.

"What a wonderful big brother we worms will have then!" says the little worm.

"But," adds the little worm, "let him not be too proud and forget us—his humble relations; and how nature made us all before she made him, and so learned how to give him that wonderful heart and brain. If she had not first made our crude little stomachs, where would she have learned to make his good one? And until she had made our little hook-feet she couldn't make hands and feet for him. Our nerves helped teach him how to feel. Our dim eyes that just enable us to tell light from darkness, taught him how to see. Our five simple little hearts helped show how one larger heart could be made for him, to feed his brain and body, and to teach him to love all his little brothers of the water, the earth and the air.

"Let him remember these things, and love all living things and be kind."

VII. THE EARTHWORM PUTS ON ARMOR

You needn't be afraid of him, little friend Earthworm. This armored monster, with his long feelers, his stalk eyes and his great crooked arms with battle axes on the end of them!

"Worse than that," you say, "they're battle scissors!"

So they are, battle scissors. Did I say battle axes?

Well, you needn't be afraid of him, anyhow. He doesn't do half the good in the world that you do. You help make the soil that grows things to eat, while he goes swaggering around—this fierce Mr. Crawfish, and his fiercer big brother, Mr. Lobster—fussing and fighting, and tearing into pieces everything they can lay their scissors on.

We're not afraid of them, are we? "Booh, Mr. Crawfish! Booh, Mr. Lobster!" We'll show them they're only worms, after all.

Why, just look at your insides, Mr. Crawfish. You needn't try to hide them under your jointed armor. We can see right through you!

See that tube running from his stomach to the end of his tail? If that tube didn't swell out into a stomach at one end, and if it wasn't inside of such a queer, armored man-of-war, wouldn't you say he was simply an earthworm? The earthworm lives on very simple breakfast food, the earth he burrows in, and he doesn't need a big stomach to keep it in until it is digested, as the crawfish does; so he doesn't have such a stomach. The earthworm's food passes right through him and digests all the way down—tastes good all the way down, too, very likely, for he doesn't have any special tongue to taste with, either.

But the crawfish and the lobster and all their near relations, eat various things. They eat little fish, scales and all; pieces of each other, shell and all, when they get to fighting, for they are cannibals. So, having many different and very tough things to grind up and digest in their stomachs, they *must* have a big, strong mill to do it with. Like all fighting animals, they are large eaters. When men spent much of *their* time in fighting, they spent the most of the rest of it in eating strong meats and drinking strong drinks—which made them want to fight still more. And so they went from bad to worse, just as the crawfish and the lobster do, and died, at last, "with their boots on." Few of the lobsters die in their beds.

See that little northeast room of the crawfish's stomach? It is not quite shut off from the main living-room. In that room are his stomach teeth. He has to have teeth to grind with, just as a hen does. But the hen, poor thing, has to use false teeth. You have seen her picking them up around the yard—little stones and bits of shell and such things, that she swallows.

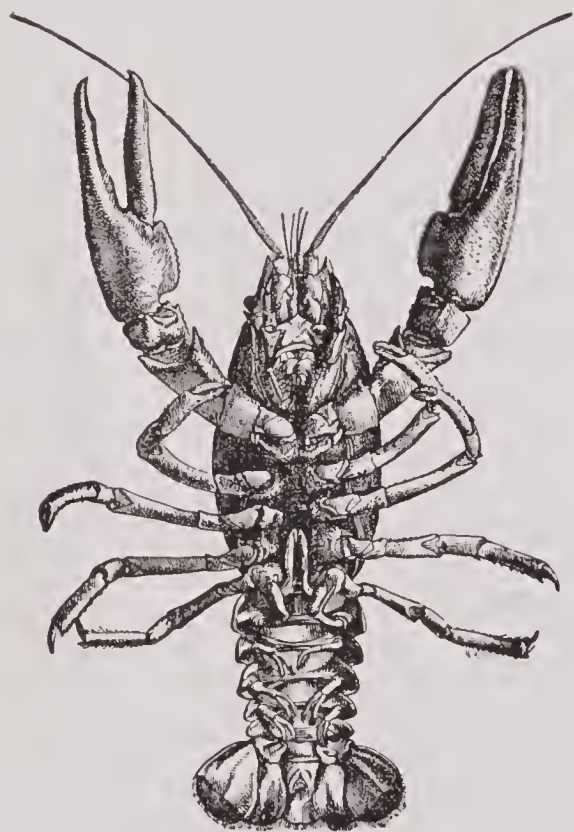
The crawfish and his kind have three of these teeth in their stomachs. With these teeth they grind finer the food that they have first torn to pieces with their pincher claws.

The crawfish seems to have started, as a baby, to divide his stomach into three rooms. When he gets to be a bossy cow, eating

clover in the pasture, he really does divide it into four stomachs, as you know. The cow stops the food that needs the most digestion in the first stomach. The food that needs less grinding stops in the second stomach. Real fine, partly digested food, like bran-mash, goes straight through, "by express," into the third stomach. All of the food finally goes into the fourth and last stomach. The first stomach rolls the coarser food into little balls. These the cow brings up into her mouth again, and chews them over. Haven't you seen cows chewing their cuds?

In the crawfish there is a big front stomach, you see, like the first stomach of the cow, that we call the paunch. In the chicken it is the crop. Next comes the

The underside of a crawfish, showing the eyes, two long feelers, the large two-claw feet, four pairs of legs, and the tail with its fringe of little hairy feelers.



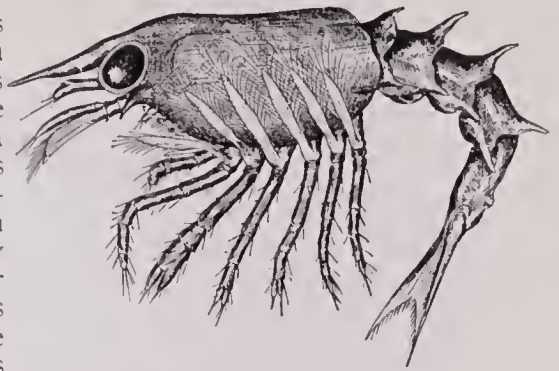
grinding mill in the northeast room, which works like the chicken's gizzard. Beyond this is the back room stomach that opens into the long, worm-like hallway that runs clear down to the tail.

This back stomach of the crawfish is lined with little things sticking out from its walls. These hold back all the food that is too large to go through. Without this "strainer," pieces of undigested food would get into Mr. Crawfish's little insides, and make him double

UNCLE SAM'S LOBSTER NURSERY



HERE are some things you would see if you visited one of Uncle Sam's fish hatching stations. These pictures were taken at a hatchery where he makes a specialty of raising lobsters and then turning them out in the ocean to grow up. Each mother lobster lays several thousand eggs attached by a kind of glue to her swimmerettes, as



shown in one of the pictures below. At these fish hatcheries the eggs are hatched in glass jars. You see the hands of a man who is removing the eggs from a mother lobster. The lobster on the right is in what is called the first stage of growth. He has lost the power to swim and is learning to walk. "Lobster" is from an old Anglo-Saxon word meaning "spider." Doesn't this baby lobster remind you of a spider?

That man is putting scrambled hen's eggs, liver and beef, finely cut, into the water to feed the baby lobsters.



Where the mother lobster carries her eggs.

The copper ticket of the lobster below says: "Please return to Wickford Station and state where found."



At the fourth stage of growth lobsters are poured into the ocean.



Lobsters are caught in a pot or trap baited with fish or meat.



In this circle are four chapters in the story of a lobster's life. In the first two stages after the egg, lobsters can swim, but when they reach the fourth stage they lose the power to swim and must learn to walk, as baby lobster is doing at the top of the page.

all up—like a boy who has been eating green apples. Isn't it queer that the stomaeh of the erawfish in the ereek, and of the cow in the pasture, should be so much alike? This just goes to show again that you can't judge by outside appearanees alone.

The blood of the erawfish circulates very much as the blood of the earthworm does. He has two long tubes for earrying it. One of these tubes runs along his baek, the other along the underside of him.

The tube at the top is a vein; the one at the bottom an artery. The vein carries the blood to his heart; the artery earries blood away from his heart. This, you know, is just what your veins and arteries do for you. You can feel the blood beating in one of your arteries by holding the thumb of one hand on the wrist of the other.

As it is much more dangerous to eut an artery than a vein, your arteries are better protected than your veins. For instance, there are veins on the back of your hand, which is always bumping into things, but you have an artery on the inside of your arm and wrist where you seldom get hurt. Mr. Crawfish seems to know he must be more careful of his artery than of his vein. Look at the pieture and see where he puts his artery.

Mr. Crawfish seems to be a little careless about the way in which he carries his heart. You see, he has it away up on his baek, between his shoulder blades, as it were. But, then, in changing and shifting parts in animals, Mother Nature seems to be a good deal as your mama is with the Spring house cleaning; she can't get everything into the right plaee at onee. But Mr. Crawfish has made the four hearts that he had when he was an angle worm into *one* heart, and that's a very great improvement.

Now here is a curious thing; the earthworm has four hearts, the erawfish has only one. You have only one; but just look at a picture of a human heart (See Heart, Vol. II, page 853) and see how many parts it has. Four? Yes, just four!

Running along the underside of the earthworm you will notice a little white cord. It is like a thread with knots in it. This is his nervous system; his telegraph line. And the knots are the stations. In the crawfish and his family, there are two of these knotted eords running side by side, and joined together, at the points where the knots are. As Mr. Crawfish thinks mostly about eating and fighting he uses his nerves mostly to run his eating and fighting maehines. So we find these little white telegraph wires running around his gullet.

In his head you will find several of these nerve knots grown together. And that's little Mr. Crawfish's little brain.

Mother Nature doesn't "cross bridges" until she comes to them; that is, she takes care of the business of every day without bothering herself too much about what she is going to do a long way ahead. She's not like the little girl who got to dreaming how much money she was going to get for her eggs, and then how, by and by, she was going to sell more eggs, and so finally get enough to buy a silk dress. You know, while she was going along thinking of everything but where she was going, she tripped and fell.

And the eggs—!

Mother Nature always has her mind on her day's work. She says: "Give us this day our daily duty, and the doing of it will keep us happy and get us ready for the next duty."

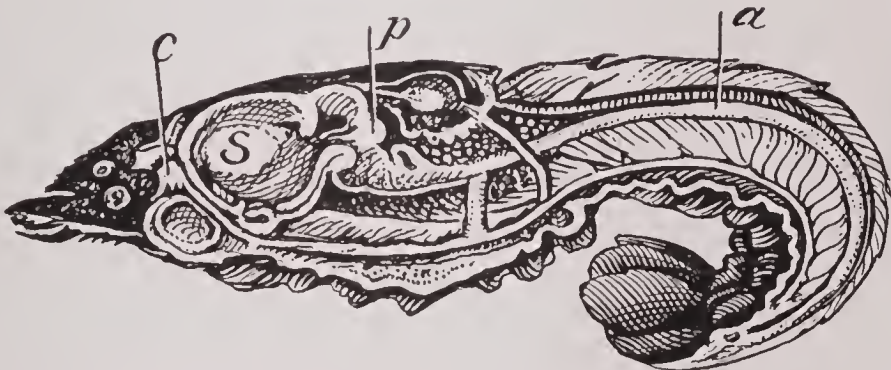
VIII. HOW THE WORM IN ARMOR COUNTS BY TWOS AND THREES

Like ourselves, the crawfish is divided into three main parts, but differently.

The front third of him carries his brain, his arms and legs, his eyes and feelers. The second third is his abdomen. The third part is his tail.

Look at this picture of the inside of a crawfish. Notice where his stomach, and that long earthworm intestine, are. Now, imagine where they would be and what they would look like, if the brain of the crawfish should grow and grow, until it was as large, in proportion to the rest of his body, as your brain is.

Wouldn't the stomach be crowded into the abdomen, to make room for the brain? And wouldn't that long, earthworm intestine be



Section showing inside of crawfish: *a*, intestine; *s*, stomach; *c*, brain.

doubled and folded, back and forth, just as you see the intestines of human beings, in the picture in your big brother's physiology?

Even in the spider, which, on the outside, is so much like the lobster, the intestine instead of being one long tube, begins to be folded, because the growth of the brain crowds it into a smaller space. The spider is much "smarter" than the lobster. She (for it is the lady spider that is so "smart") has to be much cleverer than the lobster, to catch food for herself and her little ones. She must catch flying insects with a web that she must make for herself. She must do this, not only for herself but for her babies. The lobster and crawfish lay their eggs and then go away and leave them. If they had to support their families they would have to learn to be

brighter, too. We learn in doing things for ourselves; but we learn the most and the fastest when we do things for others. That's nature's way of teaching living things multiplication.

Now, notice how nature does "examples" in addition, in making plants and animals. She seems, in her counting, to be like the funny old colored man, who was set to counting sheep.

As the flock began passing through the gate, he said:

"One, two, three—dar goes anoder, dar goes anoder, dar goes anoder!"

He couldn't count above three! Nature seems to do a good deal of her counting in that way. She fits the parts of things together by ones and twos and threes. Plant and animal life begin with just one cell. The *growth* of a plant begins with just one shoot. Sometimes there are already two leaves on it when it comes above ground. But it always *begins*, either above or below ground, with a single shoot. Then come two leaves, making three parts. As it branches, each branch begins as a single shoot. It adds its leaves in the same way—in pairs, like your paired eyes and ears and nostrils, and hands and feet. After the first two leaves, come two more, making, with the shoot, five. Then two more—making seven; and so on. So the petals of most flowers are five in number. We have five senses and five fingers and five toes. The starfish eats with five fingers. Nature seems to enjoy doing things with "fives." So don't be ashamed if you still have to count on your five fingers.

Now listen to the crawfish say his addition and multiplication table:

"I have two eyes, two feelers, two claw feet. Each of these feet has two claws. I have four pairs of legs—four on each of two sides. My body is divided, as you see, into three parts. Each of these three parts is made up of seven parts; seven rings like the earthworm's, hinged together. Seven, as you see, is $1 + 2 + 2 + 2$."

In a few members of the crawfish family, some of these seven parts have grown together. But still, even these members of the family show each of the seven rings plainly, while they are babies. There, you see, is nature's same old way of having her little ones tell the story of their grandparents. Perhaps you have read Scott's "Tales of a Grandfather." This grandfather tells the tales to the children. But in the story of the world, as we find it written in the Book of Nature, it is the children who first tell the story, if we will only look and listen very closely.

Even the crawfish's legs and the spider's legs have seven joints. In those members of the crawfish and lobster family where there are fewer than seven joints, either some of these joints have grown together, or they have shrunk up, from not being used, until they don't look or act like joints at all. Sometimes we find them turned into little thread-like legs or feelers. You can see these feelers fringing the crawfish's jaw-feet, and the end of his flipper tail.

Why and how did Nature get into this way of counting by the odd numbers, 1, 3, 5, 7? There is a reason given for this which you could not understand now. But you can easily understand it when you are older, if you keep on studying this wonderful Nature book which you see open all around you—in the woods, the water, the fields and the air.

This you *can* easily understand now: That, having begun with one part, then having added two to this one, as you see in the growing plant to keep it balanced, things *must* go on by adding twos if they are to grow sym-met'ri-cal-ly. That is a long word, but you should learn to use it. Look it up in a dictionary and see how much it means. In plants and animals Mother Nature, whatever else she does, always builds sym-met'ri-cal-ly.

IX. MR. CRAWFISH AND HIS TABLE MANNERS

When Mr. Crawfish was an earthworm he felt his way along with his pointed nose. Now that he is shut up inside of his shell—nose and all—what is he going to do?

"Why, I'll feel my way with my feelers," he says.

"And what are your feelers?"

"Those two long things that I keep moving back and forth in front of me, as I go along. You have seen the same kind of feelers on insects. Yes, and the cat—she has whiskers, you know, that she uses somewhat as I do my feelers. The mouse, too, has whiskers."

Speaking of noses, it is thought that Mr. Crawfish can actually smell with these feelers. It is a good thing Mr. Crawfish is able to smell food, just as you and I do, because nobody calls him to breakfast—nobody, except his own nose.

He must not only be up in time to eat his breakfast, but he must get it himself. "Help" is very scarce in Crawfish land. Everybody helps himself to everything he can lay his claws on, whether others have been helped or not. "Finders are keepers," says Mr. Crawfish.

In looking over Mr. Crawfish's seven-jointed legs, we found that some of these legs had shrivelled up into little hairs, fringing his tail and other parts of his body. These hairs are really fingers to him—like those big, long feelers in front; for he feels things with them.

If you have a crawfish in your aquarium at school—or the next time you meet one on the bank of a creek—move your finger back and forth in front of him. Do this some distance away; then closer.

Yes, as you will learn by doing this, Mr. Crawfish is near-sighted. He would have to hold his morning paper very close to his nose. So, being near-sighted, he must have those long feelers, like a blind man's cane, to pick his way along.

It is believed, also, that Mr. Crawfish's ears, such as he has,—for he is "near" of hearing, as well as near-sighted—are in those two bumps from which his feelers grow. Notice that he has four feelers—the two long ones we have been talking about, and two shorter ones just in front of them.

Those pinchers are to get his food with. You will know that if he ever mistakes your little big toe for a nice dinner, when you grow

to be a larger boy, and go swimming in the same river with Mr. Crawfish.

Those big front pinchers are called "claw feet." As he has two little feelers and two big feelers, so Mr. Crawfish has two big pincher feet and two smaller ones. He uses these pincher legs and arms to walk with, to fight with and to eat with.

Of course it's ill-bred to fight; and so, as we might expect, Mr. Crawfish has very bad table manners. When he finds something to eat he just "gobbles" it down as fast as he can. He does this partly because he never sits down at the table with other little crawfish and learns to say:

"May I help you to this, and this?" Or, "*Do* have some more of that."

He hunts his food all alone. He eats it all alone. He crowds it into his lonely mouth as fast as he can. He does this because he hasn't learned to think of anybody's appetite but his own. And then he's always afraid some bigger crawfish will come along and take it away from him!

"Claws were made before knives and forks," says the crawfish and the lobster, and they tear up their food as much as they can before they poke it into their jaws.

To us the crawfish seems a good deal mixed up. For instance, he not only has jaws on his second pair of legs, but at the upper end of this second pair of legs are his gills. Now the gills of a water animal, as you know, are his lungs.

Oh, no; you mustn't think that Mr. Crawfish carries his lungs around outside of him, as you carry your school books, swung over your shoulder. He's got a nice place to keep his lungs where he will not strike them with his great awkward arms and legs. There is a groove running back from each side of his mouth to two roomy places on each side of his body under his great back shield. In these two rooms he keeps his lungs.

And did you ever!—he uses his third set of legs to help himself breathe. It is as if, in order to breathe, you had to keep scooping up handfuls of air and pouring it into your lungs. For, these legs have little scoops, or bailers, on them that scoop the water up and pour it over his gills. You see he must have fresh water for his lungs all the time, just as you must have fresh air for yours; only *his* fresh air is in the water itself. When he is moving—eating, or strolling along the sandy shore, as the walrus and the carpenter did—these

scoops, being a part of his legs, scoop up water out of the sand and so give him more fresh air just when he needs it most. You know you breathe harder when you are walking or running than when you are sitting still. Nature has that way of making one part serve another. When the crawfish learns the lesson from his leg scoops, that it is best to serve one another and not fight one another, he is much happier.

And he helps to make others happy—which is the best part of it all, not only for them but for himself. It is even more blessed to give than to receive. For the happiest people are those who make others happy.

Mr. Crawfish has learned the joy of making others happy by the time he gets to be a bird—say a pigeon or a robin—with a mate and little ones, and other birds to sing to.

We'll meet Mr. Crawfish again when he gets to be a bird.

And we'll know him, too—in spite of his feathers and wings—see if we don't!

X. THE CRAWFISH, THE SPIDER AND THE FLY

If you were giving Mr. Crawfish, Mr. Spider and Mr. Fly their places in the long line of march, wouldn't you put them in the order I have named: first Mr. Crawfish, then Mr. Spider, then Mr. Fly?

I would, judging just from the looks of them. I would put Mr. Spider next to Mr. Crawfish. He certainly looks a great deal more like Mr. Crawfish than Mr. Fly does.

But we would both be wrong; for the spider is farther advanced in the scale of life than either the crawfish or the fly. So we would have to ask Mr. Fly to fall in behind him in the "procession."

Yet we must not forget there are some things in which the spider is more like the crawfish than the fly is. In form it is plain, he is more like the crawfish.

And, in one thing, the oyster is more like the crawfish than either the spider or the fly. In what way? The oyster has lime in his shell, just as the crawfish has, only a great deal more of it; while flies and other insects have no lime in their shells. Or, to put it in another way, Nature stopped using lime when she made the insects, and took it up again when she got to oysters.

Nature is a great artist in form, in color, in music; she never strikes notes that are too near each other.

Strike two notes on the piano that are side by side and see how they sound. They don't sound "right," do they? And if you play too slowly—letting the sound of one note die away entirely before you strike another, you don't get much of a tune. To make a tune, one note must run into another—the sound of one beginning before the other has stopped.

So, as you see, Nature playing her great harmonies of form and color and sound, you will notice these two things: She doesn't make the different orders of things too much alike. And yet the differences are not so great that you lose the connection.

Now, look again at Mr. Crawfish, Mr. Fly and Mr. Spider. There they go in just that order—one, two, three. Mr. Spider, although he looks so much more like Mr. Crawfish than Mr. Fly, doesn't come next to him in the procession. Doesn't it look as if Nature "skipped a note" when she made him?

Not only in the forms of things, but in the stuff they are made of, Nature does skip. She puts lime in the shells of the crawfish and the oyster, but leaves it out of the shells of insects, which come between them. Not all insects have shells, as you know, but such of them as have shells for their backs, or shell-like scales for wings, do not have any lime in them.

Why do the crawfish and the oyster have lime in their shells, while the insects haven't? Think of the lives they lead and you will see the answer. If the crawfishes and the lobster didn't wear strong armor, what would happen to them in the fighting lives they lead? And what would happen to poor Mr. Oyster, who can't fight at all, if his shell were not still thicker?

Flies, grasshoppers, butterflies and a lot of other little friends of yours, belong to the great insect family. There are several reasons why they are placed higher up than the crawfish family. For one thing they have three distinct regions of the body. In that respect they are more like human beings than the crawfish family.

Insects also have but six legs. "Do one thing at a time, and do it well," seems to be Nature's motto. So, in comparing the inner and the outer forms of different members of the animal world we see special parts developing all the time to do new things—as in the case of wings in birds; or to do old things better, as we see when we come to comparing stomachs.

The earthworm has a very simple stomach. His inside is almost all stomach; just a simple tube that digests all the way down. In the crawfish we see these "insides" are pretty much all tube. But, instead of having a lot of legs, like the earthworm, the crawfish has fewer legs; and these legs differ from each other, and are used for different purposes. The earthworm's legs are all alike and are all used for one purpose—to help him get along over the ground.

In the insects we see still fewer legs. Insects always have three pair of legs, while the crawfish has four pairs. Still higher up in the scale are the animals with only two pairs. You see how Nature makes fewer and fewer legs as she goes up and up? Finally she makes two of these four legs into wings, and lo, a bird! Or she makes them into arms, and behold, a little boy or girl! So the legs grow fewer in number and more useful. Think how much better it is to have two real good legs and a pair of arms, than to have as many legs as the earthworm or the "thousand legged" worm, and no arms or wings or anything like that—just legs, legs, legs.

As the "outsides" of the animal get more parts, the "insides" must get more parts, too, and each of these parts must begin to do a special work. The amoeba hasn't any real stomach at all; or he's all stomach—whichever way you look at it. By the time we get up to the earthworm, we find a special part that does the digesting. In the crawfish we see part of the earthworm's tube enlarged into a three-roomed stomach at one end, while the rest of the tube runs straight through him, just as it does through the earthworm.

The inside of the earthworm is all one room. The crawfish has two rooms. In the insects this inside space begins to be divided into three rooms. In animals higher than insects, these three rooms are divided more sharply. There is one room for the head, one for the lungs and heart parts, one for the digestion of food.

Even in man there are only these three rooms in the body. It is as if Nature said: "There! A three-roomed house is good enough for anybody."

But, beside more rooms, we need more inside "eating tools." The stomach, the liver, the lungs and other organs, are only inside eating tools. They divide the water, air and food up, more and more, and pass it on. It is so important to improve the inside of an animal's house, to keep up with the improvements on the outside, that Nature seems to stop all outside work for awhile to attend to this. It is in the oyster that we first find the most changes of inside parts. And this is why he is placed so high up in the scale of life, although he looks so very simple on the outside.

As we imagined the earthworm to put on armor and become a crawfish, because we could see the earthworm so plainly inside the armor, now let us imagine the crawfish going into an oyster shell to improve his insides. He takes off his many-jointed legs and eating clippers, takes off his stalked eyes, his long finger-like feelers, shrinks into his shell, makes his shell still harder, so that it will not be easy for enemies to get in and disturb him. There, in his shell castle, he makes better the parts he had, and makes new parts that he never had before.

Of course crawfish never do change into oysters. No animals change into each other in that way. It is more as it is in a family of boys. When they are boys they are pretty much alike, have the same plays, go to the same school—do everything pretty much alike. When they grow older and go out into the larger world, one becomes a lawyer, another a carpenter or a farmer, another a loco-

motive engineer, and so on. So far as the things they are interested in and can do is concerned, they are now very different. Even in appearance they have changed a good deal, too, because of these differences in their businesses. But they have changed most of all in their minds. So the forms of animals, as well as their parts, change because of the kind of lives they lead. But it makes it more interesting, sometimes, just to play things; and we are playing now, that the crawfish turned into an oyster.

In the next chapter we will open Mr. Oyster's plain old shell and see what Mr. Crawfish was "up to" when he turned hermit, and went into a shell castle to think things over.

XI. WHY THE CRAWFISH CRAWLED INTO A SHELL

If I were to ask you "What is the best part of an oyster, or a clam?" You would say: "The inside, of course."

And you would be right; but you might not mean just what I meant. There are probably no oysters in your aquarium, but you could easily have snails. Snails, clams and oysters all belong to the mollusk family. "Mollusk" is from a Latin word meaning soft. All of these animals are soft bodied.

While the mollusks are so simple on the outside, as compared with the crawfish, they have a good many more parts on the inside. The oyster is like a watch in more ways than one. It's easy to see that he has a hard case; and also that this case opens and shuts with a hinge. He also has a little heart that goes like a watch: "Tick, tock; tick, tock." So does your heart. The oyster also has two tubes, through which he breathes his food and air out of the water, and these tubes—or rather the water in them—goes back and forth, back and forth, like the pendulum of the big hall clock.

Through one of these tubes he takes the water into himself. He passes it out through the other. The water flows over his gills or lungs, and so he gets his fresh air. And with these same gills he gets his food. The gills are full of little holes, and the holes are surrounded by little paddles—just as we have seen in the sponges and the crawfish, and in some of the plants. These paddles collect the one-celled plants and animals out of the water, and pass them on to the oyster's mouth. His mouth, which is just above his foot, has four lips.

While the lobster has such a big stomach—his three-roomed stomach—the oyster has a small stomach. There are at least two good reasons for this. One is that his life is so much quieter than the lobster's. He doesn't need to eat so much. Another is that, as he has so much better inside parts to digest with, he neither needs those outside claws to tear up his food, nor a big three-roomed stomach to keep straining out the large pieces and digesting them. There are no large pieces in his food, because he lives on little one-celled plants and animals.

By dropping a little red ink from a medicine dropper into the water, near the opening of his two tubes, you can see the clam in your home aquarium breathing the water into himself and out again.

The oyster has muscles, also. Two of them are to open his two-leafed shell, and two of them to hold it tight shut. He holds it shut so tight that it takes somebody stronger than you are, and using an oyster knife, to open it. Why is it, do you suppose, that the muscles for shutting his door are so much larger than the muscles for opening it?

That's right: Mr. Oyster is afraid of burglars. And well he may be, for there are many burglars of his own kind—mollusks—who would like to break in and eat him. Some of them have drills, and they drill a round hole in his shell in spite of locked doors. These little spiral shelled burglars belong to the snail family. And there are sponges that bore holes in the oyster's shell.

The oyster has also a much higher kind of heart than the crawfish. It is divided into two big chambers, just as yours is. One is for receiving the blood, and the other for pumping it out through the body. You can easily see this little heart when the shell of the clam or oyster is opened, and count the beats.

This heart is surrounded by a thin bag or membrane, just as it is in the higher animals; and it is called by the same long Latin name. But as we are not studying Latin yet, we won't bother our heads with any more big words than we have to. Notice also that the oyster has kidneys, as the crawfish has not; and a greenish mass in his food tube. This greenish mass surrounds the stomach. It is called the pancreas. In higher animals there is a pancreas, and also a liver. Both the pancreas and the liver secrete a greenish liquid, or bile, which helps digestion.

You also notice that the oyster has little blood vessels, real vessels with branches, just as yours have. These branches are in his little foot—for the oyster is a "one-legged man." Why do the blood vessels branch only in his foot? Where have you the most and the largest veins? Yes, in those parts you exercise the most—your hands and feet and muscles. As you get nearer the heart these veins unite with each other forming fewer large veins; just as the branch lines of a railroad, from the smaller towns, unite with the main trunk line leading into the great city.

Now that Mr. Crawfish has improved his insides so much, we will see him put on his tail, change his legs to fins, his shell to scales, and go to swimming again.

Only, he will not swim backward this time, as the crawfish and lobster do. As a fish he will make a specialty of swimming.

XII. THE OYSTER LEARNS TO SWIM

Of course no oyster ever did learn to swim, because when he did learn he was no longer an oyster. It looks more as if he once knew how to swim and then forgot. You see his near cousins, the crawfish and the lobster could swim. To swim again he had to turn into something better than an oyster.

You can't imagine him coming out of his shell and turning into a fish, can you? Well, if you had never seen it you could not imagine a perfectly quiet egg coming out of its shell and turning into a beautiful bird; or a plant bursting out of a little brown seed and turning into an apple blossom. But it really wasn't just like that about the oyster and the fish. It was more like fairy fungi turning into a fern. The oyster *improved* himself into a fish, very, very slowly.

An egg has a shell of lime on the outside. So has the oyster. When the egg hatches the chicken has bones of lime on the inside. When the oyster improved himself into a fish he used the lime of his shell to make inside bones. He already had muscles, a stomach, blood vessels and nerves. But where did he get the idea of a jointed backbone? Where did he get the idea of swimming? Why, all plant and animal life began in the water. Living things were natural born swimmers. The oyster just forgot how. He was a water hermit. The angle or earthworm made ring muscles, and the lobster and crawfish jointed shells. The fish combined these old ideas of nature and made jointed ring bones for a backbone.

Perhaps the oyster got tired of lying as still as a bump on a log. He noticed the crawfish swimming and, inside, the crawfish was not nearly so well made as he. So he ought to be able to swim still better. He wasn't a bit ashamed of learning of his inferiors. So he opened his shell and his mind to his poor relation, Mr. Crawfish.

"Dear Mr. Crawfish," he said—for you can even make a crawfish good-natured and obliging if you call him "Dear Mr.;" "Dear Mr. Crawfish, teach me how to swim."

"Oh, I'm not much of a swimmer," said Mr. Crawfish, "I can only swim backward," for Mr. Crawfish, like the rest of us, is more modest and, in other ways more polite, when he is good-natured. He doesn't feel so boastful as he does when he is in a fighting mood.

"Well, you *might* swim better, dear Mr. Crawfish," said polite Mr. Oyster, "but you have wonderful legs and claws. Now I have always led a quiet, peaceable life, and I don't want any claws to fight with. And I have so much better insides—pardon me for saying so, Mr. Crawfish—that I don't need those claws to tear up my food before I swallow it. But I do want to swim.

"Now, it seems to me, that if we would take that horny stuff your shell is made of, I could divide it up into little pieces, to shingle the outside of my soft body to protect it. Then I wouldn't be afraid to come out of my shell house."

"Yes," said Mr. Crawfish, becoming enthusiastic over his friend's plans, "and when you got to be a bird you could use these same shingles for scales on your legs and feet, and to make the beak of your nose and your feathers and quills. Then, if you should happen, later on, to turn into a little boy you could use that material for finger nails and hair."

"And these scales," says Mr. Oyster, "will need to be tough and smooth and round at the edges like a boy's finger nails, so they won't get broken easily."

"But what are you going to do with that bony shell of yours?" asked Mr. Lobster. "It seems a great pity to throw it away. Mother Nature tells us never to throw anything away. And it's a perfectly good shell."

"You're right. Just let's think. I have got to fasten these strong muscles of mine to *something*. I notice you can't move anything, unless you have something to rest the lever on."

Of course Mr. Oyster is right. A boy can't pry up a stone unless he has something to rest the pryer or lever on. There was a man a long time ago who said he could move the world if he had something big and strong enough to rest a lever on. And he was right.

"I can pry myself through the water backward," says Mr. Lobster, "but if I tried to swim by moving my tail to right and left I'd break in two. Besides, my flipper tail would have to be set up on edge for the rudder to steer myself with, and I would have to have paddles on the sides to swim forward as well as backward."

"Oh, I get the whole idea now," declared Mr. Oyster, getting quite excited, "I'll take this limy shell of mine and put it on the inside, then I will have just the thing to fasten my muscles to. You see I fasten hinge muscles to it now, so I know how. I will have to divide it into jointed rings like the earthworm's muscle rings, or my

backbone would be as stiff as a—well as an iron poker. Then I'll make paddles on the sides, of the same horny substance that your shell is made of, but mixed with a softer substance so that I can furl and unfurl them like boat sails when I want to move through the water, and back up and turn and twist. The wings of those dragon-flies are made of just such stuff, but they aren't thick and tough enough for flying through the water—those beautiful gauzy wings.'

So the oyster keeps his improved insides, shingles himself with scales made of the lobster's shell, changes the claw legs into fins, sets his tail on edge for a rudder, makes an inside backbone of his limy, outside house, but jointed like the crawfish's shell, and ringed like the muscles of the earthworm. He swallows some extra mouth-fuls of air in a little bag called his "swim bladder" to make himself lighter, and away he goes through the water!

When he gets to be a bird you will see him twist his tail back again, and carry it in the same position the lobster does. It will lie flat on the air pressing it down, just as the lobster's tail lies flat on the water.

What will he do that for?

That is the very first question we will take up when we come to birds—why does a bird have his tail set on like a crawfish?

But why not watch the next bird you see; notice how he uses his tail as a crawfish does. You can easily see this because he uses it in this way just when you can watch him best—when he drops to a perch.

XIII. THE OYSTER-FISH THAT CLIMBED ON SHORE

Why we can almost *see* him do it. What? Why see Mr. Frog change into himself from a fish!

Right under our eyes, if we have him in an aquarium, where we can watch him, he changes from a water animal that swims just like a fish, to a land animal that jumps like a rabbit, a robin or a kangaroo.

So, if we ever wonder whether all the different kinds of insects and other animals could have grown out of one common cell, we have only to think of the strangely different parts that frog plays on the stage of life, in his one little lifetime; and how he came to get into the habit of changing himself like that.

It isn't the frog alone that goes through such wonderful changes. Isn't that change from a lump of jelly in a limy shell into a downy, beautiful creature with little wings and little feet and a little "chirp, chirp" just as strange? Or the change from the flower-seed to flower, and back to seed again, just as strange as either the frog's life story or a chicken's life story?

In the growth of everything in the world—all plants and all animals—there is this beginning in a lower form of life, and a growing up through higher forms. And all plants and all animals begin with the lowest form of life—with a single cell. This is the way of growth of everything: Flower seed to flower, and back again; little egg to little bird and back again to egg; egg to tadpole, tadpole to frog and back again to egg. Egg to caterpillar, caterpillar to butterfly, then to egg again.

And back again, and back again; always "saying it over" as if Mother Nature were afraid we would miss this wonderful story of the ages, and the great lesson of it all.

"You can change. You can be what you want to be. You can change your bones and muscles, but best of all, and fastest of all, you can change your minds and your hearts. You can do good things and great things today and better tomorrow, and all your life."

What has Mr. Frog to say about all this?

He says he agrees to every word of it. He says this by his actions—and actions speak louder than words. Like most other

people he seems happiest when he is young; when he is a lively little tadpole. See him flirt and flip and flash through the water, playing with his little brother and sister tadpoles, as boys and girls play with each other, in the sunshine. Later, when he puts legs on his body and teeth in his mouth, hops out into the hard world and earns his living, he has many sober moments.

It would be better for Mr. Frog if he could stay longer with his mama—or even if he knew he had a mama to stay with! And Mama Frog would learn to be much brighter and to bring up brighter sons and daughters if she stayed with her little ones and brooded them and fed them, for awhile, as the birds do.

For, as we know, it is the animals that stay longest with their mamas and brothers and sisters that are the brightest and best of all. This whole group of animals to which the frog belongs is named after the one that says: “mamma!” They are called “mammals.” All Mama Frog ever does for her little ones is to find a nice, warm shallow place in which to lay her eggs. This she does in the spring. These eggs she covers with a thick coat of jelly that helps protect them from fish and other water animals that like a breakfast of fresh frog eggs.

After while, lying in this warmed shallow water, the frog’s egg begins to grow long and narrow. A tadpole is on the inside stretching himself, after a sound sleep. And, sure enough, pretty soon, out wriggles a baby tadpole.

He doesn’t seem to know yet that he is a baby frog. He seems to think he’s an oyster; for he first fastens himself to a water weed or something of that sort, with a sucker fastener like the oyster’s foot. Later, this sucker foot turns into a mouth—or rather he lets go, and begins to swim around, and uses for a mouth what he had been using for a foot.

It is as if he said to himself: “No, come to think of it, I’m not an oyster. I’m a fish.”

And so he goes plowing himself through the water like a fish, not backing himself through the water like a crawfish. But he still carries his lungs, that is, his gills, on the outside, very much as the lobster does all his life. So, for a while, it looks as if he had “half a notion” to be, not a fish, but a crawfish.

“But no,” he says. “I think it will be more fun to play fish.” So he soon gets rid of the outside gills and grows a new set that he puts inside, under a lid—just as the fish does.

Then it seems as if he gets tired of playing fish, and thinks it would be still nicer to get up on land and hop about. Maybe he



This picture shows how a frog grows: 1, the eggs are fastened to the underside of a leaf in shallow water; 2 and 2a, tadpoles when first hatched, showing feather-like gills; 3, the gills have disappeared; 4, full-grown tadpoles; 5, hind legs begin to grow; 6, four legs appear; 7, the tail grows shorter; 8, the tail has disappeared, the tadpole has grown into a frog.

smaller—shorter and shorter. He absorbs it into his body until finally he hasn't any tail at all. No wonder he didn't eat much else—he's been living on his tail!

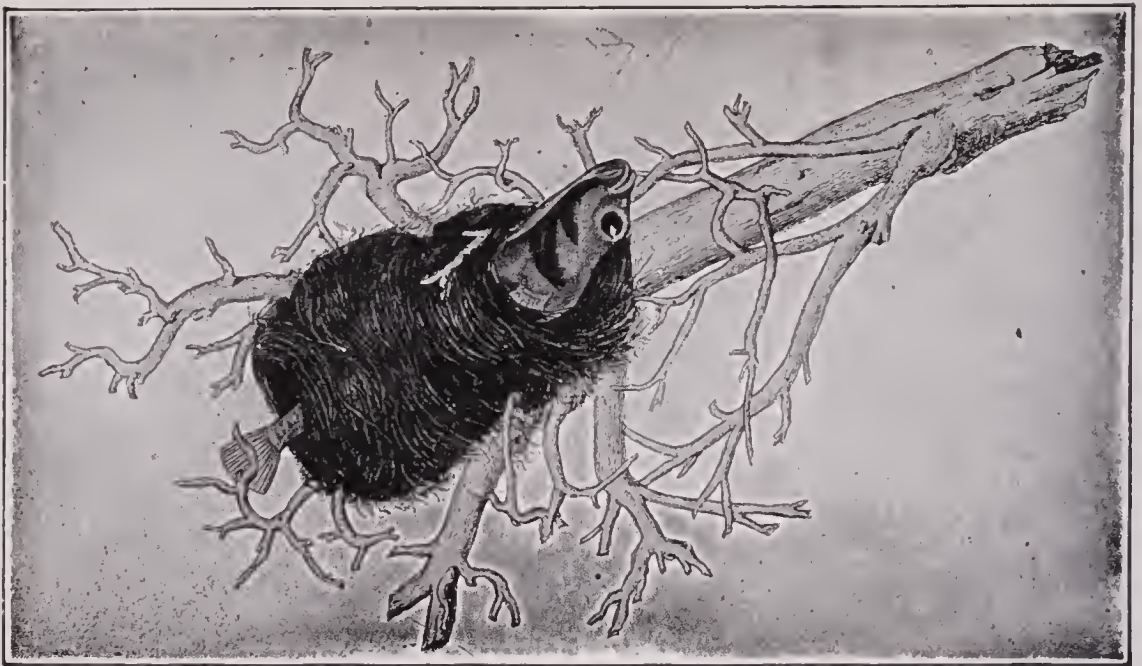
And now he isn't a fish any more at all—he's a frog. There he goes, hopping about on the shore, very lively and very happy. He keeps close to his old home in the water though, and every now and then plumps back into it; as if he wanted to keep up an acquaintance with his water friends.

Or, perhaps, he goes back to look for his lost tail!

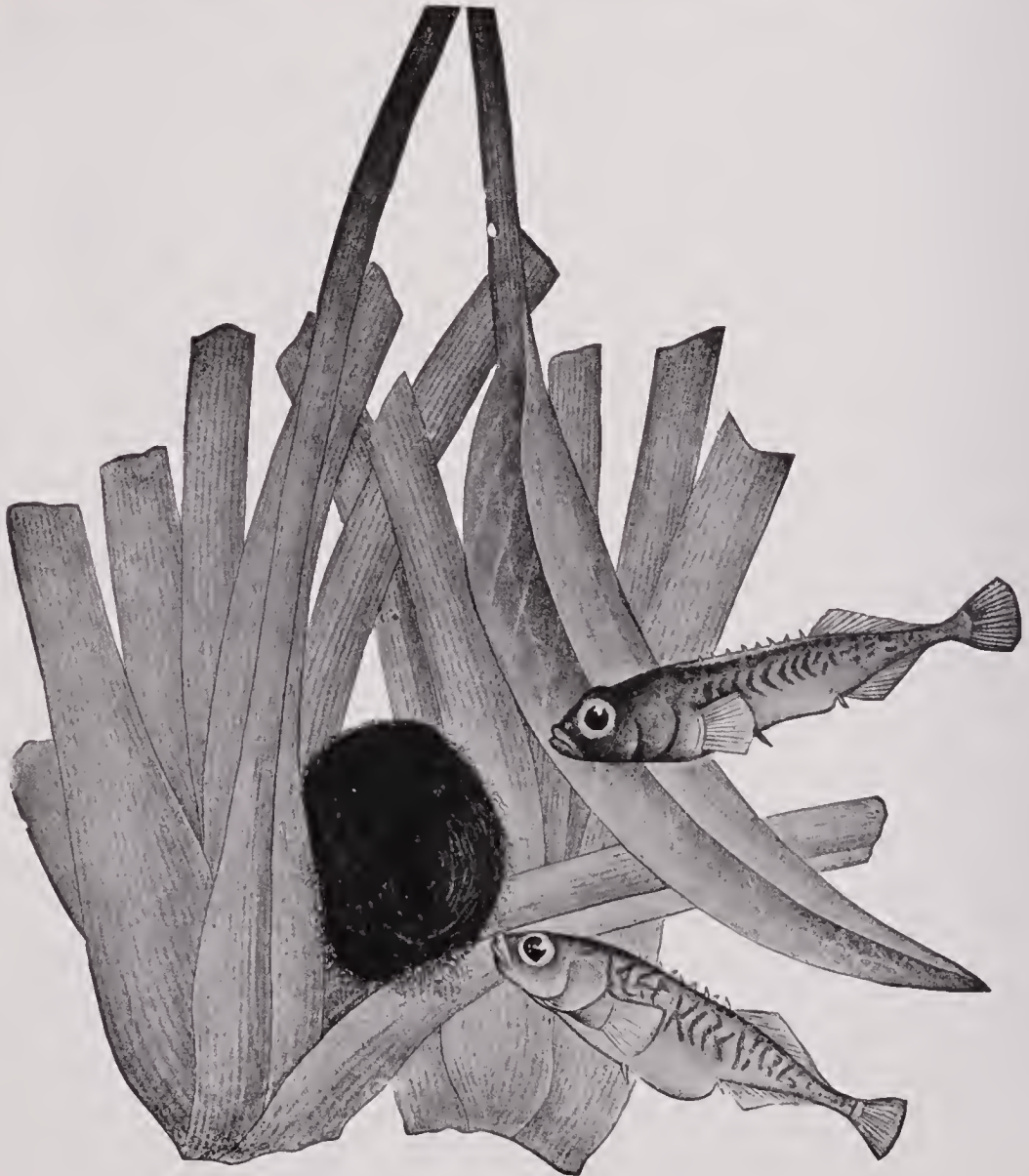
I wonder if the kitten remembers when he was a tadpole. He seems to be wondering about his tail, anyhow. See how he keeps chasing it around and around. He doesn't know as much about tadpole tails as we do—does he?

thinks about flying, too. Goodness only knows what goes on inside the heads of "little tads." They change their minds and their bodies so often, and so surprisingly, they keep you guessing. Now the tadpole seems to be thinking most about hopping. He starts to grow two pair of legs. After the legs first come he has "lots of fun" with them, kicking himself through the water as a boy swims. Yet he still uses his tail in swimming, as if he hadn't quite given up the idea of being a fish.

Finally away goes his tail! And in the strangest way. For when he's about two months old, he begins to eat a great deal less and just hangs around in the water—not swimming as much as he did, but just keeping still—thinking and thinking. His tail keeps growing smaller and



STICKLEBACK MALE ROTATING IN HIS NEST TO MAKE IT TUBULAR FOR THE FEMALE



Courtesy of Smithsonian Institution

FEMALE PREPARING TO ENTER A NEST TO LAY HER EGGS

XIV. BIRDS OF THE WATER AND BIRDS OF THE AIR

What animals build nests?

And lay eggs in the spring and early summer?

And go in large companies with their mates from one part of the world to another, at certain seasons, following the sun?

And float through the air—as the hawk does when he is sailing?

And fly, as the hawk does, when he “swims” through the air?

“Birds do all these things,” you say. So they do. But they are not the only animals that do them. As you know they are not the only animals that lay eggs either. Fish and frogs and snakes lay eggs also. Some fish build nests. Many migrate—going from one part of the water world to another, in the spring or early summer, to lay their eggs.

The fish not only foretells the birds in these habits, but even in their differences in these habits. For, curiously enough, they have different ideas about where to build their nests, just as birds do. Some, like the beautiful little sunfish, that you know so well, lay their eggs on the ground—or beds of rivers—as the meadow-larks do. Others, like the stickle-back, build in the tops of water weeds. Red wing blackbirds build up in cat-tails and rushes.

As if still further to hint that they too are related to our “little brothers of the air,” these fish that build nests in little water trees, also *guard* the eggs. It is only the fish that lay their eggs in the tops of water weeds that are bright enough to guard them. So it will be interesting for you to find, by noticing and inquiring, whether birds that build their nests on the ground are as bright as those that build in bushes or trees. More kinds of enemies get at a nest on the ground. The brighter bird as a rule chooses the better place. But you must not expect to find all birds of the trees wiser than all birds of the ground; for there are the same kind of exceptions among the families of animals as there are among families of men. The meadow-lark is very clever about hiding its ground nest.

And there are fish that fly, just as there are birds that swim. Flying fishes are found in all the warmer waters of the world. It is in the warm countries that many queer animals, that are part one thing and part like another, are found. You know a fish has a pair of fins that he wears on each side of his back in the same place that

the bird wears his wings. The back fins of the flying fish are much longer than those of the ordinary fish, with long ribs like a bat's wings.

These long, stout fins help the fish to jump out of the water—much as you may have seen a seal jump and climb up on a rock by means of his leg-fin-flippers. Then, once in the air, Mr. Flying Fish goes on flapping his fin wings and so manages to fly about three hundred yards—or the length of two city blocks.

As a frog seems to loan his webbed feet to the swimming birds, because he tried them first and found them “handy” for paddles or oars, so fish seem to have been the inventor of wings. Later, other animals adopted the wing idea, flying frogs, flying bats, flying birds, flying squirrels. The flying frog is found in one of these warm places of the earth—the East Indies. He has much larger feet than our frogs have, and he uses the webs between his toes to help hold himself in the air as he leaps from tree to tree; for he's a tree-frog.

When men first tried to learn to fly—isn't it curious?—they did just as the flying frog and flying squirrel do. They got up on some high place, spread out something against the air to hold them up, and then jumped off. Just as little boys do when they jump from shed roofs, and try to sail down with umbrellas—only little boys mustn't do this because it's bad for the umbrella—and worse for the little boys—because it's so easy to get hurt. In the same way an aeronaut jumps from a balloon, with an umbrella-like parachute to break the fall.

If you have ever noticed a flying squirrel leap from tree to tree you have seen how useful those long thin strips of skin between his legs are to him. He can jump much farther than the ordinary squirrel because these extra strips of skin make a kind of wings to hold him up, just as the tree-frog's little umbrella feet help to support him and just as the bird's wings, not only act as sails to send him through the air, but help to support him as he flies.

Notice the flying squirrel. See, he jumps—not straight across but downward, in a slanting direction. And just before he lights he does just what a bird does before lighting—he turns and goes up again. Do you know what he does this for? If he didn't do it he would strike on his nose, against the tree—and real hard, too, because he is going pretty fast. Then he'd get a nose-bleed! As it is, by turning upward in his flight, he checks himself, as a boy does when, in skating, he turns up his foot and sticks the heel of his skate into

the ice. He is also in a position to light on all four legs instead of "lighting" on his little nose.

You will notice that a bird spreads his tail much wider when he comes to light than he does when he is flying. Also notice that he curves upward, much as the crawfish does when he swims backward. See how his tail used in this way checks his flight?

As we also saw, his quills, his beak and his "toe nails" are made of the same stuff as the shell of the lobster. His bones are made of the same stuff as the shell of the oyster, and these bones and quills are hollow—like the reeds that grow by the water's edge. Remember too, that the bird, as well as the fish, has scales; and these scales on his legs are of the same shape and made of the same kind of material as the fish's scales. Its feathers, too—as you can plainly see is true of the quills—are made of the same scale stuff. And, as if to remind us of the bird's relation to the fish, on the side of his scales—these scales, when the chicken or other little bird is young, look much like feathers.

While the bird, both in form and action, is related to the fish and the crawfish on one side by his scales, his wings—which are only flying fins—and his tail, we will find that in these and other ways he is related to all four-footed things—and to two-footed and two-armed creatures. Examine the leg of a chicken and you will find there a thigh, a shin, and, of course, feet. In the ankle you will find what is left of seven bones. There are seven bones in your ankle, too; but in the bird some of these bones have disappeared and some have grown together, because the bird doesn't use his feet enough to make so many bones necessary. If you had to keep your ankle still for a long time, say in a plaster cast, the bones would grow together, and doctors are very careful to see that joints are exercised just as soon as possible, in such cases.

So, as we say that certain kinds of birds are pigeons, although they differ so much from one another; that a hawk and a duck are both birds, although they differ so much more; and that the fish, the pigeon, and the horse and the man are all alike in having backbones, so we find, the more we study men and animals, that they are alike in more and more ways than we would ever imagine, just by looking at them.

Particularly if we are thinking how different they are, which is very easy. Try, instead, to see in what ways they are like each other. That is harder, but is ever so much more interesting.

XV. WATER BABIES AND OTHER BABIES THAT DRINK MILK

As we have seen all the way through—and will see a great deal more, the more we look carefully at the picture in Nature's wonder book, the higher forms of life keep summing up the lives below, and foretelling higher lives to come.

The earthworm, with his joint-ringed body, foretells the crawfish, with his jointed shell; the crawfish foretells the fish, with his tail set the other way, and the shell made into scales. The bird is a fish with true scales only on his legs, and the other scales changed to feathers and feather quills, the fins changed to wings and the tail turned back flat, like the lobster's.

You know, when you are listening to a story, if you happen to get to listening to something else for a few moments, how the rest of the story gets all mixed up? Then you ask mama to tell part of it over again.

Mother Nature seems to want to be so sure that we will not miss the smallest part of her story—the story of lower lives growing into higher all the time. So she keeps going back and telling it over and over again, whether we ask her to or not.

The higher the form of life, the more features of all forms of life it has in it. The crawfish, for example, couldn't show us what wings looked like because his people and their near relations didn't have any wings. Nor Mr. Fish couldn't show us what feathers are because he never was a bird. But the bird can show us the fins of the fish in his wings, the fish's scales on his legs, the jointed rings of the earthworm in his backbone, the whole earthworm in his intestines.

Not only because they are made of the same stuff, and because they have similar habits, are animals that look so different supposed to belong to the same great family, but there are many "connecting links" between different animals, like the fish that fly. Go far enough down the tree of life and you will find where one branch of the family is connected with some other branch that seems as different as can be.

Fish and birds, the owl and the pussy cat, all belong to one great family—the back-boned family. But among the back-boned family those that suckle their young, as the cat does, are higher than those

that do not. Animals and people learn and go up higher in life, in proportion as they are sociable. A mother and her babies are sociable with one another. They love each other and they teach each other. The mama cat learns to be shrewd and careful because she has other little mouths to feed and lives to protect, beside her own. It is just as true in the insect world. For example, the ants and spiders are both very bright. They know how to do many wonderful things, and these wonderful things are most of them done in taking care of their eggs, and the babies that are hatched out of these eggs.

And do you know about how these ants keep other insects for cows? These "cow" insects are the little green lice that you find on plants. They are not good for the plants but they make good "cows." They give down a kind of honey dew, just as the old cow gives milk for her babies. Don't you wonder if this honey dew is meant for the babies of the aphids or plant lice? If it is true that they do give this sweet milk for their babies, they are really mammals, too, and when the higher animals feed their young in this way they are simply repeating something that is done away down in the insect world.

Another odd thing about these aphides is that sometimes they lay eggs, and sometimes they bring forth their babies alive, already hatched. It is when they have wings that they lay eggs but have no milk, and in the state that they bring forth their young alive, they have this milk. So the more we think about it the more it seems as if these little bugs are mammals, too.

But whether the aphid is one kind of a "bird" that suckles its young and so seems to want to remind us still more of the relation between birds and mammals, it is certain that there are egg-laying animals that suckle their young. One of these is the spiny anteater. Another is the duck mole. You can see from his name that he must be something like a duck and something like a mole. He burrows in the ground and suckles his young like a mole and he has a bill and lays eggs like a duck.

Then there are fish that suckle their young. They might be called fish because they live in the water, and swim like fish; or they might be called sea-lions because they have sharp teeth and eat meat like dogs or lions, and suckle their young as the lioness does her cubs.

As we find some mammals laying eggs—most of them seem to have dropped their egg-laying habits with their wings—so we find

some mammals that have wings but that do not lay eggs. Thus the great families of nature seem to be held together on both sides; just as you keep yourself in a tree by holding on to two different limbs, one with the left hand and one with the right. Bats have wings, as you know, much like the wings of a bird, and much like the fins of a fish, with great spiney ribs running through them. But bats suckle their young just as Mama Dog does her puppies.

Notice how, in still another way, Nature seems to want to make sure that we see that we are all relations and should be kind to one another and find joy in studying each other's lives and in making these lives as happy and helpful as possible.

As we have seen that the lowest forms of life, both animal and vegetable, begin in the water so, in each new class of animals, there is this same grading up. Each begins as a water kind, goes up to land kinds, and then to tree kinds. Among the birds there is the duck that lives most of the time in the water. He swims more than he flies. Then there are the long-legged, long-billed birds that live most of the time on the edge of the water. There are other birds that build their nests in bushes or low trees near the water, and get their food from the seeds that grow on water plants or by catching fish or other water animals. Higher up are other birds that build their nests on the dry land in the meadow far away from the water. Others build in the bushes, higher up; others in low trees; still others in the tallest trees. You know how much brighter a crow in a pine tree is than a goose on a pond.

So with the frogs—water frog, toad, a kind of land frog, and a tree toad; and even a flying frog. Notice the same thing among the rodents; the animals with sharp front teeth, like the two that first appear in baby's mouth. The beaver is a water rodent; the ground squirrel, rat and mouse are ground rodents. Then there is the tree squirrel and the flying tree-squirrel.

Water insects, moist-place insects, dry-land insects, bush insects, tree insects. Water mammals—the whale; “whales” that climb on rocks and get themselves called seals, “sea-lions” or sea-dogs; then our own home dogs. And some of these love water, like the water spaniel and Newfoundland dogs. Some are land dogs, like the fox, the wolf and greyhound. Others of this great dog-toothed, flesh-eating family—the “carnivora”—like the bears, can climb trees. They really do climb trees to get the food that a little insect brother, the bee, gathers and makes over in its own body to feed its

young just as mama bear gives milk out of her own body to feed her cubs.

How did animals and plants come to be so much like other animals and plants; and plants and animals so much like each other in shape, in their way of growing, moving and feeding and reproducing? Why does the growth of every tree keep showing us how many different kinds of things each little seed can grow into—root, bark, leaf, blossom, fruit? One answer is that all things are related to one another, branched out from the same beginning, just as great families grow into brothers and sisters, uncles and aunts; cousins and second cousins—differing more and more, as a rule, as they are more distantly related.

Another idea is that all the great families of animals—as bees and bears, birds and fish, horses and elephants—were made different in the first place, but yet made to resemble each other in these many unexpected ways to teach us how much we can learn from one another, and do for each other.

Anyhow we can all agree that living things are much more alike than we might suppose, when we know little about them, whether we agree as to just how they got to be so much alike or not.

And we can all agree, also, that it is much better to see where we are like other people in the things we believe, instead of quarrelling over the things in which we differ from them; and that, whatever else we believe, we can be sure that we are the happiest and most useful in proportion as we live to help every other body and every other thing—if we know and feel that all living things are little brothers in the water, the earth and the air.

NATURE STUDY

PART I—FLOWERS

EDITORS' NOTE TO MOTHER AND TEACHER—One day, more than sixty years ago, a group of young men in Harvard University were assigned a lesson in Zoology, by a new professor from Switzerland. He told them to study a live fish swimming in a tank. Every day for two weeks the class was sent back to look again at that fish. Then the teacher went to the tank with his pupils, and gave a lecture an hour long, on the things they had failed to see. The professor was Louis Agassiz. His method of teaching from the natural object, rather than from a text book, gave such amazing results that he won world-wide fame. His class-room was crowded with eager students who afterwards, having learned to see what they looked at, made discoveries in the natural sciences.

It took a long time for this Nature study idea to work down into the primary grades. We have to get our knowledge of everything about us through the five senses. As the senses are keenest in childhood, that is the time to get into the habit of seeing. The successful man is the one who sees the most and best, and who grasps the meaning and relation of things, and applies them to his own particular affairs. The first object of nature study, then, is the training of the powers of observation. *What* a child observes matters little, so long as it secures his absorbing interest. *How* he observes it, matters a great deal. Any one flower, tree, insect, bird, animal or other natural object, truly seen, is as inexhaustible as Professor Agassiz' fish, and is bound in infinite ways to the whole material universe.

The following studies in nature are offered as examples and methods. Older people should read the article on Nature Study, in Volume III, page 1307. It is a summary of the best educational thought on the subject, and gives plans to be followed in practical work. Midway of the common school period, in the fourth and fifth years, educators have noticed that there are "lean years," when interest in books flags, and a child learns little and cares less. Nature Study gives the child something he wants to look up in text and reference work. It cultivates his sympathies, tastes and judgment, and makes him talk and write with eager intelligence. A microscope, a camera and a case for arranging and preserving specimens, are valuable helps.

PART I—FLOWERS

I. A WILD GARDEN AND ITS TENANTS

This is the story of a wild garden that was found near a public school on the edge of a big city. None of the children had the tiniest garden, and they were not allowed to pick flowers in the park, even to use in the school room for nature study. So this wild garden, where they could pick armsful of flowers, where they could pull plants up by the roots, where they could gather seed cases and cocoons, and watch insects at work, was a wonder and delight.

Even the teachers did not know it was a garden, at first. It was a vacant block of land two hundred feet square. All around it ran a new cement walk. The ground was two or three feet below the level of the street and would cost a good deal to fill in. Perhaps that was why there were no houses on it. The soil was very poor. From the walks the earth crumbled away in steep banks of gravel, sand and yellow clay. Water lay in sunken places, making frozen ponds for sliding in winter. There was a fallen tree-trunk and two or three rotting stumps of scrub oaks, around which mosses and low ferns grew. In the spring the ground was boggy, and scantily covered with ragged weeds and wire grass. Strips of blue grass turf below the walk, were dotted with the golden heads of the dandelion. In the wettest places a few clumps of blue flag lilies and pussy willows were found. Along one bank were brambles that, in June, blossomed the single pink flowers of the wild rose. And there were clover blossoms.

But that was all. When school closed in June the lot was covered with tall, coarse, ill-smelling weeds that gave no promise of flowers. But when school opened in September, the place was a jungle of purple and yellow, with swarms of winged visitors.

On the strip of green sod under the edge of the walks, the dandelions still showed bud and blossom and gauzy seed globe. But they did not take all the space. The grass was thick with the trefoil leaves and round buttons of white clover. And here and there was the glossy-leaved, pink-flowered spike of smart weed. Clambering up the bank grew a strong, rough-stemmed little vine with leaves

like a wild strawberry. At every twisted whorl of leaves was a tiny, star-like flower, as yellow as a butter-cup. It was the cinquefoil. Cinquefoil means five-leafed, as trefoil means three, so the little vine really was a far away cousin of the strawberry. Among the cinquefoil were clumps of mint. Their long, hairy stems and fuzzy leaves were topped with frowzy heads of lavender-pink, fringed with silver and breathing spicy smells. In every corner, and in many a crack of the sloping bank, stout burdocks were rooted. The pinkish-purple-topped green burs, in heavy knots, leaned out over the walk to catch in the clothing of passersby.

Farther afield tall thistles lifted royal purple heads, crowned with plush. They had a soldier guard of sharp lances and spears set on stem and leaf and flower. But, unafraid, wild morning glory vines twined around their spiny columns and hung out delicate pink and red and white flower bells. The morning glories clambered up the dusty stalks, and bloomed among the small, pale, yellow flowers of the mulleins.

In that wild garden were four varieties of clover—the white, creeping clover of blue-grass lawns; the pinkish purple-headed clover of farm meadows; the tall, shrub-like sweet clover, with tassel blossoms of white, and a blood-red clover, with pointed heads like pine cones. The crimson clover is a foreigner. Grown all over Europe, it is not often seen in America. In that wild garden it was a well-born emigrant among hardy and rough American weeds.

Except for the clovers, the smart weed, the morning glories, the white parasols of tansy, the mint and a few fiery spikes of the cardinal flower, the garden was a haze of yellow, spotted with purple. The long plumes of the golden-rod made a background for everything else. Against its feathery masses were set the dazzling yellow of the field sun flowers and black-eyed Susans. Much of the mustard had gone to seed. The tall plants were hung with tiny green pods, but there were still some clusters of yellow, cross-shaped flowers.

Lower down, hidden in wire grass, were yellow-flowered sorrel, with acid leaves that the children liked to nibble. There was many a sturdy bunch of butter and eggs, with their cream and gold, lipped and spurred blossoms set on spikes, the country cousin of the snapdragons of gardens. There were seed spikes and broad leaves of dock and plantain; the peppery seed sprays of the tongue grass, that gave a feast to all the pet canaries in the neighborhood, and the catnip mint that made pet pussies go into spasms of delight. But these

plants only added to the green of the leaves. The purple notes in the riot of yellow were given by the royal heads of the thistles, the reddish purple spikes of the iron weed, and the violet and lavender ray-flowered clusters of wild asters.

For several days the children were puzzled by an odor as sweet as that of lilies of the valley. It could be smelled only at night, when the garden lay dim and dewy under the moonlight. The perfume was traced to weedy stalks with small green-sheathed buds. They were not noticed by day, but opened pale, yellow, five-petaled rose-shaped flowers, after night fall. It was the evening primrose that grew in the shelter of dense thickets of golden-rod and asters. Big moths visited the primrose by night. In the day time the shrivelled blooms held drops of honey so sweet that wasps with steel blue wings passed all the open flowers by, to drink that nectar.

Above the whole field insects were always on the wing. A little white butterfly was fond of the purple thistle. Bumble bees visited the thistles, the field clover and the butter and eggs. It was very funny to see a heavy, buzzing black and yellow bumble bee drop on the lower lip of a butter and eggs blossom, tip it down and force its greedy head into the long honey-filled spur. Little honey bees liked the white clover best. The golden-rod plumes, when in full blossom and gold-dusty with pollen, were always spotted with little black beetles that could scarcely be shaken off. This same little jetty beetle liked the dandelion pollen, too.

Gauze winged dragon flies darted here and there; grasshoppers by hundreds leaped and clicked their wings, and robins and jay birds from a nearby park made raids on the grasshoppers. A dozen varieties of butterflies were seen by day, and many a moth by night. On every dewy morning the webs of spiders were strung, with diamonds. The caterpillars had spun their cocoons on the stoutest of the weed-stalks, and flies grew sluggish in the cool nights. In dry places, and between the cracks of the walks, were little domes of sand, honey-combed with tiny holes. These were doors to underground houses of red and black ants.

Soon there were many seeds flying about—seeds of the dandelion, the thistle, the golden-rod, the milkweed. There were seeds with tails and wings and gauzy sails, and hooks and bursting pods. Every breeze loosened and scattered them. When frost came and killed the blossoms, the garden was a feeding ground for birds that ate the scarlet hips of the wild roses and the seeds of weeds.

One sunny day of Indian summer, late in October, some boys digging for pupas of beetles that had gone to sleep in the ground, found a nest of field mice, and caught a glimpse of a chipmunk on a rotting stump. It was sitting on its haunches eating an acorn from the park. Alarmed by some noise they made, it whisked its tail and vanished. The hole to its underground home was found between the roots of the stump, hidden by feathery ferns and mosses. The school was wild about the discovery. So the teachers got books and pictures, and a dozen rooms were busy for a month studying and writing stories about chipmunks and ground and tree squirrels.

The wild garden furnished this school living things to study all the year around, in plants and insects. Don't you want to know some of the things they found out? You can find most of these plants and insects by many waysides in the country, and on vacant lots in cities. And you can get help in understanding them by looking up their names in this book.



DANDELION, SHOWING PLANT, FLOWERS AND SEED HEADS

II. LITTLE LION TOOTH AND ITS COUSINS

In the spring, the grass that bordered the cement walk around the wild garden was not two inches high before it began to be dotted with the golden rosettes of the dandelion. When the warm fingers of the children closed around a bunch of short stems, the flowers soon closed into green-sheathed buds that refused to open again. So a boy who didn't like to come to school, but who did like to roam in the fields and woods, was sent to bring in a whole plant. He was gone an hour, but he brought a fine plant, and such a fine story of how he got it that he fairly ran back to school.

At first he tried to pull a plant up by the root. But the flower stems and leaves broke away. Then he dug around the base of a plant a little way, and got hold of the crown of the root. That snapped an inch below the ground, breaking off a stout root half an inch thick. At last he went home and got a long, thin-bladed, table knife, that he sank in the soil to the handle and slipped all the way around the root to loosen the soil. When he pulled, the root snapped six inches under ground, leaving the tip buried there. Then, for he was a clever, determined boy who wouldn't give up, something like a dandelion in that, he dug a trench around the plant and sank the knife deeper. He tried six times before he got a whole, unbroken root. But he got it!

"Bravo! Stout little lion-tooth; you know how to hold on!" said the teacher, clapping her hands. The children were puzzled. Did she mean the boy or the plant? Perhaps both.

"Lion-tooth?" cried a dozen excited voices. Why, yes. The French people long ago noticed that this wayside flower has a narrow, tooth-notched leaf, so they called it *dent-du-lion*. In England, where the meaning of the name was not known, it was changed to dandelion. You know a tooth doctor is a *dent*-ist. Very likely the lion part of the name was given because this kind of plant is king of all plants, as the lion is king of the animals. The English people had a name of their own for it. They called it Peasant's Clock. A peasant is a farmer. Farmers have to get up early and go to bed early. The dandelion opens its yellow eye at four o'clock and shuts it at eight or nine—a very good clock for farmers. Another old

English name for it is Blow Ball, because of its gauzy, feathered seed globe that every wind scatters.

The root of the dandelion is round, rough, tapering from crown to tip, almost black on the outside, brittle but tough, hollow in the middle, giving it strength with lightness, and with many root-hair water suckers. The leaves grow in spreading, flattened circles from the crown, with the flower stems set around the inner circle. Rain, falling on leaves and flowers, drains right into the hollow root. So the dandelion begins to use water at once.

The dandelion opens day after day, the blossom head growing larger, and its stem stretching and lengthening into a hollow, rubbery pipe. When pulled the stem stretches a little, like rubber, before it snaps. And out of the broken end oozes a thick, milky sap that stains the hands brown and makes them feel sticky. The sap of the rubber tree is a thick, milky fluid much like that of the dandelion. The dandelion has some rubber, resin, sugar, and a bitter medicine in its sap. Do you know of any other milky-sapped plants? Milkweed!

Did you ever split a hollow stem of dandelion in strips, and pull it through your mouth to make a bunch of curls? It tasted bitter, didn't it? Every part of the plant has that bitter taste, very strong in the old roots, just a hint in the young leaves. In the country, people often gather the young leaves of dandelion with mustard and curly dock leaves, and cook them for greens. They are better than spinach. The French use their *dent-du-lion* leaves for salad, as we use lettuce. Indeed, lettuce is a cousin of the dandelion, so is chicory or endive, another salad plant. They both have that slightly bitter taste and milky sap. All of the plants of this family are useful in making medicines. One of them is called *solidado*, which means to cure, or to make whole.

When there were plenty of blossoms of the dandelion everywhere, each child brought a big one, as round and yellow and as many rayed as a baby sun, to school. They traced the circles of yellow strap shaped petals, and tried to count the sunny rays. They got their finger tips all gold-dusty with pollen and learned, in that way, how the honey bees and butterflies carry pollen away on their legs. They found that the rays all had their stems sunk in a soft, green vase. With sharp finger nails they split the sides of the vases and spread them open. The rays just fell apart, so one could be picked out and studied under a microscope. Growing upward from the

little swollen base of each ray, were shining threads tipped with buttons or pollen dust—seed makers!

“Why,” said a surprised little girl, “just this yellow ray and the things growing on it look like a whole flower!”

“It is. A dandelion head is a whole bouquet of flowers in a cup.”

“It’s something like a United States of flowers, isn’t it?” asked a boy.

“That’s it! A great scientist has said that the motto of the dandelion and its cousins seems to be ‘United we stand.’”

Really, the dandelion might be chosen for our national flower. It grows everywhere; it blooms from April until frost, and it is hard to conquer, once it gets a foothold. Its root goes deep and lives over winter. You may cut the plant off, burn the ground over, or plow it up, but the smallest root tip sends up a new plant. Every seed globe scatters it far. Count the seeds of the Blow Ball. Sturdy, determined little Lion Tooth, it hangs onto every one of its thousand chances of life.

There is another reason why it might be a good national flower. Its ray flowers, its toothed leaves, its long, swaying stems and gauzy seed globes could be used in many beautiful forms of art. They could be used as rosettes and borders, and the bases and capitals of stone pillars. See what pretty designs in charcoal, crayon and water-color you can make from studies of the dandelion.

These many-in-one flowers are called composites. All the ray flowers belong to this family—the daisy, the sun-flower, the asters, the chrysanthemums, dog-fennel, rosin-weed, thistles, the—guess! But you never will—the golden-rod!

That tall, rough, weedy stalk, with hairy leaves and long, drooping plume of flowers doesn’t look at all like the ray flowers. The separate flowers are more like fairy lily bells. But a number of them are crowded into one head, and the seed are ray-feathered for flight. Like the dandelion, the golden-rod grows everywhere on good or poor soil. It sends down a stout root that fights for its life, and it makes countless seeds.

The composite flowers are the highest in the plant world because they can live and grow, and make and scatter the most seed under the hardest conditions. They are not at all concerned about being useful to men. Nearly one-eighth of all the plants on the globe are composites, but many of them are troublesome weeds. The daisy,

the aster and the chrysanthemum have been improved into beautiful garden flowers, and the lettuce and endive into salad plants.

The whole insect world seems to help these composite flowers. Bees and wasps and flies and beetles visit them. Moths suck their honey by night. They have enemies, too. Grasshoppers eat their leaves. Crickets and beetles lay eggs on them. Caterpillars bore tunnels down golden-rod stems. The aphid, or plant louse, sucks their juices. But the ant, the red spider, the insect-eating birds, and toads and frogs find a thicket of golden-rods and asters a fine hunting ground, and destroy these enemies. On the strong, weedy stems a tiny wasp builds a gray paper house, and under the plant are to be found bumble bee nests and the cocoon cradles of many insects.

The composite plants are little books of nature. You could spend a long season finding out all the interesting things they could tell you. See COMPOSITAE, DANDELION, DAISY, ASTER, CHRYSANTHEMUM, GOLDENROD, THISTLE. Plate, Volume II, page 686.

III. A "GOOD LUCK" FAMILY

Did you ever find a four-leafed clover? It's good luck to find one. With a four-leafed clover in your shoe you can walk right in among goblins and witches in any fairy story, and they can't play tricks on you. Long, long ago people thought any clover leaf was a charm. Most clover leaves have three leaflets, and three is a lucky number. Besides, many of the leaflets are marked with white, daintily penciled horseshoes, and everybody knows a horseshoe is lucky. But ask any farmer and he will tell you that clover is a good luck plant, whether it has three leaflets or four, or is marked with a horseshoe or not. When you read this story you will find out why.

Clover is one flower that you can always find in June, and June is the leafy month when there are few flowers. The Spring blossoms are gone, the orchards are done blooming? But there are acres and acres of purple-pink clover heads in blossom, all over the land, and more acres of the violet-purple clusters of alfalfa, a first cousin of the clovers. The round buttons of the white, creeping clover dot every green lawn, and the blood red cones of the crimson clover grow along many a wayside.

How far one can smell a field of clover! It is a breath of the country as sweet as the perfume of orchards in bloom. Over a clover field there is always a pleasant hum of bumblebees and honey bees, and the glimmer of wings of gay little butterflies. When the feast of the clover is spread all the winged world goes to the party. Let us go, too.

Look out for Mr. Bumble Bee in a clover field! Big, fuzzy, black and yellow worker, he isn't thinking about you at all. But he blunders about, bumping into things, and he thinks human beings are enemies, as they very often are. He's a good friend of the red clover, and he often makes his nest in the ground near the roots. He drops on a fine flower head and pokes his long honey-sucker mouth to the bottom of the flower tubes. Pull one of those flowers yourself, and suck the base of it. You get a sweet drop, don't you? The white clover is sweet, too, but the honey bee feeds on that. The tubes of the white clover are short, and the bumble bee has a regular fishing pole of a mouth, too long for such shallow pools of nectar.

White clover is called the honey suckle of the grass, and bee keepers often plant whole fields of it.

Because it has so many flowers on one head, you may think the clover is a cousin of the dandelion. It isn't. The flowers are not crowded into a green vase, they just grow very close together on the swollen end of a stem. Pull the colored tubes from a clover head, and you will see that you have left behind every one some tiny upright threads. Those are the seed-making parts. Put a pink tube under a microscope and see how it widens, at the top, into pouting lips something like a sweet-pea blossom. Clover and Alfalfa are really cousins of the peas and beans and peanuts, and other plants that ripen their seeds in pods. You know the pods of peas and beans that you can split to shell out the seeds? Clover seed, too, grow—one or two, in a fairy pod below the tubular blossom. It is hidden, for the flower tube dries and turns brown on the head. The pod of the peanut is a woody, papery shell that grows on buried stems like potatoes. The seed-pods of alfalfa are coiled in snail-like spirals, and the teeny weeny seeds of green or yellow are exactly the shape of kidney beans.

How much a sweet-pea blossom looks like a butterfly. One of the names of this class of plants is a long Latin word that means butterfly. You can always know them by the blossom, although some of them are low creepers and some are beautiful trees. Do you like liquorice candy? Liquorice is a cousin of the clover and peanut. It is a woody shrub sometimes called the sweet root, for it is from its root that the liquorice juice is made. The sensitive plant, whose leaves go to sleep if you touch it, is one of this family, too; and the indigo shrub that gives us our beautiful blue dye. Another very tall relation is the beautiful honey locust tree, with its clusters of pink butterfly blossoms. It grows in many parts of our country. The clovers are members of a very big, important family, aren't they? They are all great honey makers.

All of these butterfly-blossomed, pod-seeded plants have strong, fibrous roots. There is a central root-stock with many branches, and a bush of rootlets, like a leafless shrub turned upside down and buried. This gives them a strong hold on the soil and many water suckers. Their stems are very zig-zaggy, branching in a twisty kind of way, as if they didn't quite know whether to be vines or not. The white clover, and the dear little Shamrock of Ireland, spring from creeping, vine-like stems. Many peas and beans climb on poles, or

on other plants like cornstalks. Alfalfa is more bushy, and with smaller leaflets than the clovers. The acacia, the sensitive plant, and locust have long, feather-veined fern-like leaves.

Beside the bees, the pod-seeded plants have another animal friend. He lives in the ground, on the roots. He is so small you can not see him except with a very good microscope. But you can find the house he lives in with hundreds of his family. Find a fine field clover or alfalfa plant, and soak the ground around it with water until you make a very deep mud puddle. Then pull, loosening the root gently, so as to get as many rootlets as possible. Wash the earth away from the root in a tub of water. All over the root-fibres you will find funny little brown wart-like knots and swellings.

Those knots are the houses of little animals called bac-te'ria. This is how they help the plants. All kinds of plants need a food called nitrates. There is some in most soils, and some is supplied by animal manures that you often see spread on gardens in the spring. In the air is a great deal of gas called nitrogen. The leaves of plants cannot use that gas. They send it back to the roots. Clovers and other pod-seeded plants have these little animal friends that fasten themselves in colonies on the roots, and use that nitrogen gas to make nitrates. So those little swellings are really nitrate factories full of busy workers. They make more nitrates than the plants they grow on can use, and leave some in the soil for wheat and other crops. So, you see, the clovers are soil-makers, and bring good crops and good luck to the farmers.

If you see pussy prowling around a clover field, leave her alone. Pussy eats field mice. Field mice eat baby bumble bees. If the mice were so many that they ate all the bumble bees, the clover would have no help in making seeds. Then bossy cow would have no clover to eat, and couldn't make as good milk. And we wouldn't have as sweet yellow butter to put on our bread.

Isn't that just like the house that Jack built? Dear, dear, but this is a nice, mixed-up, friendly old world, where everybody helps everybody else, and has a fine time doing it.

Sometimes, clover will not grow in a field at all. Men who make a study of plants found out that this was because there were no nitrates in the soil, and no nitrate making bacteria to help the plants make them. So the farmer's department of our big country, in Washington City, began to hatch bacteria in liquid baths. Cotton is soaked in this bath and dried. This cotton is sent to farmers who

ask for it, together with some food the little animals like. The cotton and the food are put into a barrel of water. In a few days the water turns milky, and is then swarming with the little creatures.

The farmer lowers a sack full of clover, alfalfa, peas or bean seeds into the water, dries and sows them. The bacteria begin to grow as soon as the seeds do, and set up their little nitrate factories on the roots. If you can't grow sweet peas in your garden, or white clover on your lawn, ask Uncle Sam in Washington to help you. He will send you some of the cotton, and you can use the milky water for sprinkling.

It isn't a bit of use to sow these bacteria with any other kind of plants than pod-bearers. And here's another funny thing. When clovers and their cousins are grown in soil rich in nitrates, they do not take the trouble to make this plant food at all. You may pull up many a fine clover or alfalfa plant and find no swellings on the roots at all.

You have heard the story of Bruce and the spider, haven't you? No matter how many times the web is torn down the spider spins another one. Some animals will give up, if disturbed too often. So will some plants. The clovers are like spiders. They try, try again to grow seeds. If left alone they ripen their seeds from the first blossoms and the plant dies. But if clover is cut when in blossom, but before the seeds ripen, it will spring up and blossom again, and even the third time. Farmers can cut two and even three crops of clover from one field, in a single season. Then, if he lets the seed ripen, the alfalfa and some clovers, will re-seed the field, or spring up from the roots the next season.

It really seems as if those wise little clover heads might be nodding in the wind as if to say that they knew a thing or two, doesn't it? (See LEGUME, FRUIT, CLOVER, SHAMROCK, ALFALFA, PEA, PEANUT, BEAN, INDIGO, LIQUORICE, LOCUST, NITROGEN-GATHERING CROPS.)

IV. THE BONNY BRIAR BUSH

It was a little bird that told how the wild rose came to be growing in the wild garden.

There wasn't another wild rose anywhere in the neighborhood. Roses are something like human babies. They do not like the smoky air of cities. You can coax garden roses to bloom in front door yards and parks, but wild roses stay outside, where the air is pure and sweet.

When winter came, and the gray weed-stalks rustled their dry seed-cases in the wind, the rose seemed the only live thing in the waste place. Its thorny, leafless canes were a bright red-brown. Its scarlet seed-hips glowed like little coals of fire above the first November snow. The rose-hips were as big and heavy and red as the little apples of the hawthorn tree. And they were so firmly fastened to the woody stems that the wind could not loosen them. Some foolish robins, who had stayed in the north too long, made a breakfast of the rose-hips and started south for the winter.

Birds have perfect little mills of stomachs for grinding worms and seeds, but rose-hips are so thick and hard that it must take the birds days to digest them. The seeds inside are like little stones wrapped in spiny hairs, so they pass right through the birds unharmed, and are planted far away. In this way the wild rose has been scattered by birds over many parts of the northern world, from very cold countries almost to the hot tropics, and far up mountain sides. Some bird had dropped rose seed in that jungle of sturdy weeds in the city. It took root and grew there, because it happened to fall on a bit of soft, rich ground near a rotting stump of scrub oak. But it never grew very large or bore many blossoms.

The rose has a woody stem that grows, year after year, in rings, like a tree. Some people call it a rose-tree. But it is only a shrub or bush, the promise of a tree. The wild rose is often only a clump of separate, thorny canes. On them you can find the tiny leaf and flower buds in winter. And in the spring you can peel the thin, satiny bark away, and find the green layer of the new growth under it.

In March, when the buds begin to swell, put some branches of the wild rose in water, in a sunny window, and watch the leaves unfold. They are compound leaves of five, seven or even nine oval,

saw-notched leaflets. Where a rose leaf joins a stem, two ears or wings are set, giving it a broader, firmer hold. The under side of the leaf is furry, or even a little prickly along the mid-rib, and there are sharp thorns on trunk and branches.

Thorns are curious things. They start to be leaves or branches but get nipped, in some way, so they turn into thorns. They are very useful to roses. They help the slender canes catch on supports, and they frighten away some enemies. Little boys and girls would be sure to pull too many sweet roses if it wasn't for the scratchy thorns. Can you think of any other plants that have thorns? Thistles? No thistles have spines and prickles. A true thorn has wood and bark. Blackberry and raspberry briars have thorns. So have crabapple and hawthorn trees. Those plants, too, have five-petaled, rose-like, fragrant blossoms. Perhaps—but wait a minute. Don't think too fast!

The blossoms of the rose grow in clusters at the ends of the branches. You find there a bunch of hard green buds that seem to be the swollen ends of stems. The bud is solid where it joins the stem, but the covering of the tip is parted into five, thick, green, leaf-like scales that are folded around a hard center. Those scales are called sepals. As the bud swells, pink lines peep out between the sepals. Then, slowly, the sepals separate into five pointed lips of the solid, round flower cup below. They flare back and show five, broad, pink silk petals set in a fluttering rosette.

Just five in the wild rose! Once in a long, long time you may find ten petals, for you know there are some plants born with a genius for going up higher. The rose is so beautiful, and it has such a sweet smell, that it has been petted and fed and helped to grow better, in sheltered gardens, for hundreds of years. In every country it was just a little different, even when wild. It was a tiny shrub a few inches high, in far northern places, a tall bush or a long, trailing vine farther south. And it has been transplanted and the pollen crossed, so many times, that it has been wonderfully changed. From the single pink, or white, or yellow blossom, the rose has grown into the many-petaled, many-tinted queen of the garden.

It was easier to improve the blossom of the wild rose because, just inside the circle of five petals is a little forest of pollen-tipped threads, around the five button-topped columns in the middle. The rose makes more pollen than is needed to grow seeds. It has no honey to give to bees and butterflies. It has its pretty color, its

sweet perfume and its pollen to attract friendly visitors. These pollen threads are very ready to drop their yellow dust and broaden into petals. And they are just as ready to turn back again. If the seeds of the finest, double garden roses are planted, they sometimes forget all their long training, and go back to the single-petaled blossom and straggling canes of the wild rose. They have to be grown from cuttings to keep them tamed.

Left alone, nature might never have made one of our double roses of the garden. She doesn't seem to care to make the *flower* better. All she thinks about is the seed. As the rose must depend upon birds to scatter her seeds, she tries to see how tempting she can make the fruit, so the birds will be sure to eat it. When the pink petals fall, the seed cup swells and closes its mouth, leaving those five sepal scales to turn dry and brown at the top of the red hip. The rose hip is too hard for some seed-eating birds to manage in their little insides, so one member of the rose family made the soft, sweet, seed-filled fruit of the blackberry. Another one made the raspberry.

Yes, those plants are cousins of the rose. They have the same bright-barked, thorny, woody stems; the same spiny, compound leaves, and the many five-petaled rosette flowers, with forests of pollen-tipped hairs in them. In the briar berries the blossoms are white and the pollen dark. Down in the grass nature set the same white, rose-blossom on a creeping vine, and scattered the hard seeds on the outside of a sweet fruit, like stitches of yellow silk on a red satin cone—the strawberry!

Of course, no one knows which of all the rose family came first. Very likely it was the little yellow-flowered cinquefoil that looks so much like a wild strawberry. Beside making seeds it also grows by runners, that strike root at the joints. So does the strawberry. If raspberry and blackberry canes are bent over to the ground, they will often strike root, and start new plants. And branches of roses, and many of their cousins, can be grafted on other root stocks. So can the branches of orchard fruit trees be grafted.

How much the apple blossom looks like the wild rose. It has five pink petals set in a rosette. It has a little forest of pollen hairs, too. When the petals fall the seed case swells and closes at the top and leaves, at the flower end, five little dry, brown sepals. The leaves of the apple tree are furry on the under side, the bark of the tree is smooth and bright, and the wild apples—the hawthorns and

crabapples have thorns. The apple tree is a very near cousin of the rose, nearer, very likely, than the strawberry. There are many varieties of wild apples in different countries—the Siberian crab-apple is a useful fruit in its wild state. Like the rose, the wild apple has been trained, fed, sheltered, transplanted, cross-pollinated and grafted, until there are now dozens of varieties of big juicy apples in our orchards. The pear and the quince are near cousins of the rose, too.

The wild plums and cherries are not so near. They have a single nut-like seed in a stony case. They grew, perhaps, in a round-about way, from the almond, and so did the peach and the apricot. A peach stone is pitted like the paper shell of the almond, and the peach seed is often mistaken for the nut of the bitter almond.

It is the rose that gave the name to the family. *Rosaceae* is the name. Isn't it pretty? It ought to be, for every member of the family makes the earth fragrant and cheerful with their bouquets of blossoms. The rose is so sweet, so innocent and beautiful that we borrow its name for little girls, as we do of the blossoms of the violet and the lily. In Japan, where they grow orchard trees for the flowers, they often call little girls plum blossom and cherry blossom.

Every member of the rose family is like the bonny briar bush in disliking the smoky air of cities. They grow best in the open country, under the wide, blue, sunny sky, in clean earth free from weeds, where birds build their nests and there is a pleasant hum of bees. And here is a secret very few people know. You can find the wild rose blossom in winter. Find a beautiful rosy apple. Cut it across the middle. Then cut a thin slice from one half and hold it up to the light. You will find the five rose petals these, very plainly marked, in the heart of the apple. (See ROSE, STRAWBERRY, RASPBERRY, BLACKBERRY, APPLE, PEAR, QUINCE, ALMOND, PLUM, CHERRY PEACH, GRAFTING. Plate, Volume II, page 686. POLLINATION.



COURTESY OF DEPARTMENT OF EDUCATION, NEW YORK STATE

APPLE BLOSSOMS

TREES

PART II

A YEAR IN THE FOREST

EDITORS' NOTE TO MOTHER AND TEACHER.—Do you remember Eagle Heart, the little red American boy? His home was in the forest. We cannot find such a beautiful forest in our country today, as the one he lived in. No big tree had ever been cut down, except by the beaver dam-builders. The Indians had only stone hatchets. They used poles and bark to make their wigwams and canoes. For fires they used fallen trees and branches and dry brush. They were careful to put out their camp fires, so that very few forests were burned.

In the old world the woods had been cut over, and only the best timber and orchard trees replanted, for many hundreds of years. It was a very great wonder to white people who came to America, to see hickory, walnut and ash trees, oaks, maples, beeches, elms, poplars, willows, birches and wild fruit trees, flowering shrubs and vines, and even pines and other evergreen trees growing together, in the most natural and friendly way. In any bit of wild woodland, in any city park, and on village streets and lawns, you can find most of these trees, and some others that Eagle Heart never saw at all. White people brought the beautiful horse chestnut, and the tall, slim, Lombardy poplar and other trees, from their old homes.

How many of these trees do you know? Eagle Heart knew and loved all the trees in his forest home. Perhaps you know several of them in the summer, when the leaves are on, but he knew them in every season of the year. He knew their height, their color, their spread of limb. He knew their bark, their leaves, their flowers and fruits. He knew where each kind of tree liked best to grow, and what animals and birds and insects used it for a home. And he knew the forest as a whole, in all its seasonal changes.

After three hundred years of cutting down trees, we have begun to re-plant and protect them. Even the schools have a tree-planting or arbor day, so little citizens can help in the work of winning back our lost trees. The more you know about trees, the more you can help in this work. Don't you want to know and to love them as Eagle Heart knew and loved them? The first thing to do is to visit trees, and make some pictures of them with your little kodak eyes. (See ARBOR DAY, FOREST RESERVE, FOREST-SERVICE, LUMBERING and the names of different trees.)

TREES

PART II

I. SPRING: "ROCKABY BABIES"

Where do you look for flowers in the Spring, and when? Why, on the ground, of course, and in late April or early May.

The Indian boy looked *up*, in March. He saw flowers much earlier than you do. The air is warmer than the ground in the early Spring. Before the snow goes off the red maple lights the edges of the woods and the banks of streams with its blood-red blossoms. Against the cold, gray-blue sky of March the maples look redder than they really are. The flowers are so small, and so crumpled and bunched in little tufts on the sides of twigs, that you may think them only the first leaves. Frost nips a good many of them. Entire clusters fall to the ground, sometimes on the snow. You can easily find and study them.

You will find a number of tiny blossoms snuggled together, inside a raincoat of varnished brown scales lined with wool. The separate flowers are fairy cups, some with pollen pockets on little hairs, like clappers in bells, and others with eager arms or plumes stretched out asking for pollen. It takes both kinds of flowers to make the winged seed of the maple, and they both grow on the same tree. The bees get their first sweet breakfasts of the year from the ruby honey cups of the red maple.

A week or two later, the Indian boy looked for the flowers of the rock or sugar maple. They are not so easy to see, from the ground, for flowers and leaves come together, and both are a pale yellowish green. The flowers are not bunched, and each cup hangs by a hair-like thread. The whole tree has a feathery, spring-like look that tells everyone who knows anything at all that the sweet sap is running up. The tree pumps up thirty or forty gallons of water in flowering time. The silver maple flowers early, too. Its blossoms are in thick short tufts of greenish white, much the color of the leaves. The flowers of all the maples grow on the sides of the twigs. The leaf-buds are at the ends.



DOGWOOD.



HONEY LOCUST.



PUSSY WILLOW.



CHESTNUT.



CHESTNUT OAK.



RED OAK.



WHITE OAK.



BUR OAK.

The snow is still trickling away in little icy streams when the first willow pussies come out for an airing. You will not find them on the big willow trees, but on bundles of knobby switches of willow shrubs that grow with their little webby root feet in the water. The bark is a brownish-green satin, with gummy, scale-covered buds set at regular spaces along the slender, leafless stems.

These scales open, and furry gray noses poke out to take note of the weather. If the sun is shining, the pussies slip right out and sit, as if with toes and tails under them, like so many maltese kittens. You like to rub the silken pussies on your cheek, and you almost expect to hear them purr. But in a few days they swell and stretch and bristle, like kittens with their backs up about something, until every gray hair shows a grain of yellow pollen under it. Shake a twig and see the gold dust fly!

The big willow trees know better than to bloom so early, when Jack Frost nips foolish pussies. When the April sun is quite warm, the black willow takes the brown water-proof caps from its flower buds, and pushes out some catkin tails as scaly as pine cones. Each row of scales is dropped over the next lower one as neatly as the shingles on a church spire. They have no fur, for nobody needs fur in April. Under the scales are seed bottles with eggs in them, but no yellow pollen to feed them. Somewhere nearby, there is sure to be another black willow tree with no eggs, but with pollen catkins as yellow as gold. The bees visit both trees for honey, and so carry pollen to the eggs. The yellow tassels fall very soon, but the scaly ones stay on the trees awhile. By and by the seed babies under the scales get so big and downy that they tumble out of the nests and fly away.

All the catkin bearing trees—the willows, alders, birches and poplars, make these feathered seeds. In April and May, the woods are full of flying white flakes. One poplar is called the cottonwood because of the snow storm of downy seeds it sets loose. The alders are mostly shrubs, growing with the willows along the waterways. Their scaly, worm-like catkins, that you can see in winter, swell into long feathery tassels of purple and gold. On the same bushes are little erect cone-catkins that bear the seeds. The birches like drier soil. You know these white-barked wood fairies, don't you? The birches are shy, and so are their blossoms. You have to lift the thin scales of their catkins to find the thinner scales under them, and the hidden pollen. The tassel grows feathery, and the downy

wood sprites of seeds seem to ripen and vanish in a day. The birds use the cottonwood and willow seeds to line their nests with down.

A great many trees flower in April, when the wild flowers in the ground are just poking little green cones through the warm blanket of last year's leaves. The pollen-making blossoms of the elms are little chimes of bells, yellowish or reddish green and, in some kinds, greenish purple. They have so many sturdy little yellow-tipped clappers that you almost expect to hear them ring. In the elm, as in nearly all forest trees, it takes two kinds of flowers, working together, to make seeds. So some of the blossoms of the elms have no clappers, but hairy arms that reach for pollen food. The wind brings it from other trees.

The elm seed is a round, notched and fringed and double-walled green scale, with the seed between two layers, just like the powder in a toy pistol cap. The seed hang in bunches, by inch-long hairs, until the wind tears them loose and scatters them. At the same time in May, the red maple drops its two-winged seeds. They look very much like the thumb screws that you use to tighten bolts, only, of course, they are thin and green.

Oak trees also have two kinds of flowers. One kind is a dwarf catkin or cone, with several double pockets full of gold-dust. The egg flower is a tiny pink knob. It sits away out on the end of the twig in a scaly cup, often snuggled up to a sister or two, like a little bump on a log. Its pink mouth is as wide open as a baby robin's when crying for worms. It wants that pollen! You see, it is a baby acorn. When it gets the pollen it swallows the food, shuts its mouth tight, turns green, and just sits there and grows all summer.

The acorn is really a kind of nut. And you might say that all of our forest nuts are made in much the same way as acorns. The chestnut seed-cone grows on the same twig as the pollen-catkin. As there are to be three nuts in one bur, it has three mouths to be fed with pollen, all set in one prickly cup.

The black walnut doesn't bloom until May. Its catkin has forty pockets of gold-dust, each one a sort of treasure shelf under a green scale. But the nut blossom is no bigger than a grain of wheat. You have to look sharp to find it. Two or three of them often grow together, on the tip of the branch, after the leaves come out. Small as they are, each has two mouths open for pollen. Why two, for one nut? Crack a walnut, a hickory nut, an English walnut or a pecan. These nuts are in two, fat, wrinkled leaves, with a woody

partition between them. But they are joined across the middle like Siamese twins.

You can make a very close guess as to what the fruit of many trees will look like by studying the blossoms that hold the little eggs. You know the sweet, three-cornered little nuts of the beech tree, don't you? The squirrels know them. Three nuts are fitted together in the husk, so, in the egg blossom, which is just a tiny grain, there are three little, three-cornered mouths to be fed. The pollen blossom is a globe-shaped bell, with a dozen powder-tipped threads.

What would you think the blossom of the wild grape should look like? A many-branched cluster of flowers, for one thing. The flowers have five petals and five pollen threads, and a many-celled egg cup for the many seeds of the grape. But the flower petals do not flare open. They are almost closed into little grape shaped globes around the seed-making parts. The flower stalk, with ever so many branches and separate flowers on it, may be only an inch or two long, but it is a whole baby bunch of grapes.

Do you notice that the grape has both of its flowers, the seed cup and the pollen threads, set in one blossom? This is the first one of the kind we have found. The catkin bearers, the maples, the elms and all the nut trees have two kinds of flowers. One is a pollen maker that falls as soon as the yellow food is scattered. The other is an egg blossom that is fed, and stays on the tree awhile to ripen the seeds. In the grape, the two flowers are brought together, and set in a five-petaled cup, or ball.

The same is true of the wild crabapple and hawthorn trees of the woods. Plants with these united flowers are called crown-bearers. They are of a higher order than those that have to make two kinds of blossoms to grow seed. The crabapple blossom is so large that you can find out just how it is put together. The stem ends of all the parts are packed in a solid green cup that swells out on the end of the stalk. In that cup are little eggs in five nests. Growing up from the nests are five, hollow, white columns with moist, spongy buttons on top. Around these columns is circle after circle of yellow-tipped pollen threads, as many as thirty of them. And outside of these is the rosette of five pink petals, held up by the five green sepal scales, or flaring lips of the egg cup.

Bees brush the yellow pollen onto the white columns, and the grains of gold-dust send hair-like roots down to the little seed eggs.

Then the petals fall, the seed cup closes and swells, the sepals dry into five little brown scales at the flower end. The apple grows big and juicy, and ripens brown seeds in five satin-horn lined nests in the heart.

The crown-bearers do not use their own pollen, but exchange it with flowers on other trees of the same kind. Such a flutter of silken, scented petticoats; such a buzzing of bees and hovering of butterflies as goes on in those huge bouquets of pink and white! Beside what we call the wild fruit trees—all trees and low plants, too, bear fruits, for fruits are seeds, you know—there are the honey locusts, the horse chestnut and buckeye trees, and many crown-flowering shrubs, in American forests.

The honey locusts hang out long clusters of pink butterfly blossoms, like nosegays of little sweet peas. The honey bees go frantic with delight over them. In June, the horse chestnut gives its second surprise party of the year. Don't miss that for anything. You can find these handsome trees in lawns, parks and along village streets.

The swollen cone of the horse chestnut flower bud is in the heart of a cluster of five-fingered leaves, often a foot long and broad. The big white blossoms are on erect, many-branched spikes, so they form a giant bouquet. Each blossom is a fluttery, ruffly cup, penciled and dotted with purple and yellow. They are deep honey pots, into which bees tumble, head first, jostling the hanging pollen pockets and bumping into seed column tips. When the petals fall in a little snow storm, the seed grow in husks, into dark brown nuts, much like big, flattened acorns. The horse chestnut is a foreign cousin of the American buckeye tree. The Ohio buckeye that gives its name to the state, has clusters of smaller greenish flowers, and the sweet buckeye long, narrow, yellow flowers in green cups.

Under the lowest limbs of the tall forest trees are the flowering shrubs. The wild briar berries have clusters of white rose-like blossoms. There are bouquets of white-flowered dogwoods, pink sprays of red-bud, and yellow torches of the spice bush. The elder shrubs have showy parasols of tiny white blossoms, and the laurel makes banks and drifts of pink snow on rough hillsides.

This is the forest in flower, as the Indian boy knew it. Do you wonder that he loved it? If you learn to know it and love it as he did, it will call you out every day from March to June.

II. SUMMER: "IN THE TREE TOPS"

Summer is the leafy season. But the time to begin to study leaves is in the early spring. On nearly all trees the leaf comes as soon as the blossom falls. The first leaves are very small, and they are not green but pink, red, yellow, gray or white. They have been wrapped up in bed clothes all winter. It takes several days of warm sunshine for them to turn green and to grow up. The leaf of the red maple tree, true to its name, is red. On the sugar maple it is a yellow-green, on the silver maple a shining green-white. When they grow to full size these maple leaves all have much the same form. In different members of a plant family there is a resemblance, as in a human family. You can learn to call each one by its "given," as well as by its family name, by looking out for the differences.

When you see a tree with a leaf that would lie in a three to five inch circle, but that is cut down part way into five lobes, you would be safe in thinking that tree a maple. The lobes of the red maple are sharply notched and parted. In the sugar or rock maple, the leaf lobes and partings are more rounded. It is a darker, smoother leaf, too, and grows more thickly on an evenly balanced, round-headed tree. The red maple has straggling branches, and the leaves are thin so light sifts through them, giving the tree an airier look than any other maple.

The leaf of the silver maple is smaller, a sage green above, a cottony white below. It does not sift light, but seems to reflect it like a mirror, as the white underside turns up in every breeze. There are other maples, but these are the best known. The leaves of all trees and of low plants, too, are alike in being brighter and smoother on the upper side. The underside is paler and rougher, and the veins stand out more plainly. This is because the upper side is a sort of rain and dust coat and sun-umbrella, for the breathing pores underneath. It is the lower side of a leaf that is the most interesting to study under a microscope.

All of the willows have long, slender leaves. Each leaf is a narrow, thin, delicately veined blade that grows by itself, and alternately, along a slender stem, making a sort of feathered branch. The pussy willow leaves are a bright green. The black willow leaf is broader, saw-notched, and it tapers toward both stem and tip

like a canoe. It is bright green above and silvery underneath. The leaf of the white willow is a gray green lined with silver, and it droops from yellow stems. The crack willow, whose twigs snap so easily, has a green leaf lined with a waxy coating. The weeping willow has long, sad, gray "weeping" leaves.

The leaves of the alders are darker and broader than those of the willows, and the undersides are hairy. The poplars all have broad, heart-shaped leaves of emerald green satin, many of them silvery underneath. They are always in motion, so they shimmer in the sun in quite a dazzling way. The tall, slim, Lombardy poplars seem robed in dark green, flowing satin.

After the maples and willows, very likely you know oak trees best. The oak leaf is very irregularly shaped, like the oak tree. It is a long, oval or pear-shaped leaf, usually narrowest at the stem end, and is deeply notched and lobed. It is a strong, tough leaf as glossy above as if varnished, and rough underneath, with woody veins standing out like a net-work of cords. The scarlet, the red and the black oaks have about five, sharply notched lobes with broad partings, and each lobe is often notched again. The white oak has seven or nine narrow, rounded lobes, with very deep rounded partings cut down almost to the midrib. The bur oak has five or seven broad round lobes and narrow partings. In the swamp oak the leaf is deeply and irregularly scalloped. The chestnut oak leaf is oval with shallow scallops, and the smaller live oak leaf has wavy edges.

The oaks ring all the changes from many sharp, almost spine-tipped lobes to wavy edges. And they are very puzzling, for they are not all alike even on one tree, nor in different seasons. The best way to be sure of an oak tree is to study the acorns. Oaks can be as tricky as they like about leaves, but they stick each to its own pattern, in making acorns. So, in the fall, when the acorns drop, you can study the oaks again.

After these tantalizing oak leaves, it is always such a comfort to turn to the American elm. That tree can always be depended upon to make a certain leaf. Along its high branches, that curve over in great plumes, the elm sets an oval or egg-shaped leaf about three inches long, narrowest at the tip and just a little pointed. The elm leaf grows singly, on opposite sides of twigs, each a little advanced beyond the last, and making a neat, feathered spray. The leaf is strong, saw-notched, short stemmed and firmly set, smooth above, rough underneath. From the midrib the veins slant upward, making

evenly spaced broad V's, about a quarter of an inch apart from stem to tip. You might think these veins were laid off with a ruler. Isn't that a satisfactory kind of leaf? You could almost draw it without seeing it, couldn't you?

The leaf of the beech tree is something like that of the elm, but thinner, softer, often fringed as well as saw-notched along the edges, and it is irregularly net-veined, not strongly feather-veined like the elm. The tree, too, is so different that you could not mistake them. The beech is a broad, low-branching tree, leafed all over as heavily as the maples.

The orchard fruit trees, wild and tame, all have rose-like leaves. Apple tree leaves are a soft green above, lighter and furry underneath. They grow in tufts around the fruit and along the stems. The cherry leaf is smaller, darker, brighter, and more blade-like than the apple leaf. The foliage of the pear tree is larger and thicker; of a peach a long, slender, bright green blade like a very large, rather curly willow leaf. On the thorny canes of the briar berries are broad, spiny compound leaves that tell very plainly their kinship to the rose. In open spaces of the woods, the wild grape spreads its tent of broad, deep lobed and toothed leaves. They are very glossy and dark green above, hairy and pale underneath. And among them are curling tendrils and bunched clusters of little green fruit.

In every forest you will see several trees that have what are called pinnate leaves. Such leaves have three or more pairs of leaflets set on opposite sides of a central stem, with a single leaf at the tip. So, in a pinnate leaf, there are always an odd number of leaflets, five or seven in the rose, about nine in the leaf of the white ash tree. This is a beautiful shade tree, of hard wood, ranking with the rock maple and the elm. The leaf is quite nine or ten inches long, and the leaflets long oval blades very bright and clean. The mountain ash, or rowan tree, has as long a leaf but with a greater number of narrow leaflets, giving the tree a feathery, almost fern-like look. The honey locust, too, has this feathered leaf of many drooping leaflets.

Many of the nut trees have these beautiful drooping pinnate leaves. The black walnut is hung all over its high crown with long plume-like leaves with from seventeen to twenty-five slender leaflets. The leaf of the butternut, or white walnut tree, has from seven to nine. The horse chestnut, buckeye and hickory trees have palmate leaves. That is, the broad oval leaflets are all set around the tip of a common leaf stem, spreading in a circle, like the ribs of a palm

leaf fan. The largest, middle leaflet of the horse chestnut leaf is often ten or twelve inches long, and four or five wide.

It is a wonderful thing to see a horse chestnut burst into leaf in April. This tree has thick stems and big, scaly leaf buds like little pine cones. The outer scales are brown, and water-and-frost-proofed with gum. Inside is layer after layer of green scales each lapping over the next. Inside of all these is a tender, pink, leafbud baby, snuggled in a blanket of fleecy white wool. Now watch and see one of these undone, for all the leaves of all trees come out in much the same way. You can study Mother Nature's way of wrapping up and taking out her leaf-bud babies in the horse chestnut best, because its buds are so large. One by one the cover scales are turned back as the baby stretches too big for its cradle. Then, on a warm day, five crumpled pink toes wriggle through the fleecy blanket. Suddenly, the bed clothes are kicked off, the pink toes spread into five leaflets and the whole tree tumbles, green in a day, into the sunlight. But it takes the leaves days and days to grow up.

The paper or canoe birches have the prettiest fairy-like leaf in the world! It is a broad oval, three or four inches long, with finely toothed edges. The pointed tip is often curved over a little, in a graceful, tricky way. This is a way many leaves have of being a little out of balance. If you fold any leaf along the midrib you will find the two sides are never exactly alike. This is just as it is in the faces of little boys and girls. One cheek has the dimple, one eyebrow is lifted or eyelid drooped more than the other. It is these little things that keep any two faces, even of twins, from being exactly like any other, and gives every face what we call character, or individuality.

The birch leaf has this little tilt at the tip, now on one side, now on the other, with a little hollow cut out below it. A thin, fluttery, transparent leaf, scantily scattered over the lace-like twigs of the slender white-barked trees, it glances like a butterfly and sifts sunlight. A group of birches always have a dryad, wood-fairy look. Step softly when you come upon them in some shy retreat in a forest. They look as if a snapping twig might startle them into taking flight.

III. AUTUMN: "WHEN THE WIND BLOWS"

What is it the magician says in fairy stories, when he makes the most surprising things happen?

"Presto, change!" and he elaps his hands.

Jack Frost is this wonder worker of the forest. After a still, sharp night in October, a hundred things seem to have happened all at once. The ground is white with frozen dew. The trees are great torches of gold and red. They blaze all the brighter because the sky is veiled with a violet haze.

It is the maples that first light up our woods with these flickering fires. No country of the old world has trees that make such a wonderful color show as our maples. Their leaves are never of one tint, but are mottled and shaded, from lemon yellow to orange, flame-red and crimson. You know the thin-leaved red maple sifts sunlight. To look up through one, in the fall, is like looking through a splendid stained glass window of a church.

The oaks show no yellow, and the leaves are of a strong solid color. But different varieties of oaks give them a range of all the reds from scarlet to wine, and then add warm browns and bronze greens. The elms and beeches are in russet yellows, the birches and poplars pure gold, the nut trees yellow. On every brook the willow leaves float like little fleets of sunny canoes. The fairy craft drift down stream, swirl over eddies and go under.

Below the boughs of the tall trees, all these colors are repeated in the shrubs and vines. The sumac is a burning bush with torch-cones of seeds. The broad leaves of the grape vine turn to bronze. The berry briars are dark as the wine oaks. The big, smooth sassafras leaves are mottled in orange and flame, like the maples. There are notes of purple in the clusters of wild grapes, in the leaves of the alders and some of the ashes; and of scarlet in the seed hips of roses, the clustered berries of the mountain ash and of the bittersweet vine. Below all these the foot-high seedlings of the forest show the colors of the parent trees, among the brown of frost-bitten ferns and fallen leaves.

There is no hurry about anything. The autumn trees often take three or four weeks of Indian summer to strip their boughs for winter. The leaves drift down, silently, like great colored butterflies. Whole

troupes of them dance in little gusts of wind. On frosty nights the nuts drop with soft patterings. Squirrels slip, brown and gray shadows, over the bright carpets, laying in their winter stores. The song birds take their last meals of seeds and cocoon babies and fly southward.

October is the time to study the fruits of forest trees. Many of the trees—the willows, poplars, elms and red maples drop their seeds in the spring. The rock maple keeps its seed until frost, and so do all the nut trees and the wild orchard fruits. All the maple seeds have two thin, flat green wings, like a thumb screw, an inch or more across. In the thickened bases of the two wings, two seeds lie coiled. You can peel away the thin, paper-like covering and find them. And you can learn how they begin to grow by pulling up the smallest seedlings of the red maples.

Acorns lie thick under the oak trees. They will tell you the names of the parent trees. But keep very still and the squirrels will tell you some things. The gray and brown squirrels and the little striped chipmunks will pass some acorns by, but will pick up others eagerly and scamper away with them. Up the trees they go, or into hollow logs or holes in the ground, to their hidden store-rooms. They like the sweet acorns of the white, the chestnut and the live oaks. They have to be very hungry before they eat the bitter nuts of the black, the red and the bur oaks. How can they tell them apart?

Very likely all acorns look alike to you. They all have a shiny, brown shell with a white "eye" where they grew fast to the cups. The acorn of the white oak has a very rough, mossy cup much shorter than the pointed nut. The bur oak is often called the over-cup oak because its mossy, fringed cup covers quite two-thirds of the round acorn. In the live oak of our southern states, the cup tapers back to the twig, broadens at the top and almost encloses the acorn. The red oak has a shallow cup, more like a saucer, the scaly ring just clasping the long oval acorn. The scarlet oak acorn is top shaped, with a point for spinning, and is half covered with a shaggy cap of a cup, like a tam-o-shanter. There are other oaks, with acorns that are still different, but these are the best known.

Chestnuts are very near relatives of the oaks. The cups are closed burs, very stiff and woody, with prickly thorns. You have to let Jack Frost open them for you. He can split them into four leaves lined with brown velvet, and make you a present of three dark brown, flattened nuts with silky tails. They are very sweet when

roasted by a winter fire. The squirrel is out before you are after chestnuts. Did you know he often peels his nuts, stripping the horny shell away, before storing it in his high pantry. He puts away chinquapins, those tiny American cousins of the chestnuts. He likes the little three-cornered, thin-shelled beechnuts that grow, three together, in a prickly bur. He gathers hazel nuts, too, picking them from the flaring, clustered husks that grow on low bushes.

Would you think the squirrels could manage the hard shelled walnuts, butternuts and hickory nuts? The black walnut has a thick, stony, wrinkled, black shell, and it is buried in a tough green husk with no partings. You have to let these husks dry a little and turn brown. Then you pound them off. They stain your fingers brown. The butternut is a white walnut. Our grandmothers used to dye homespun cloth brown with butternut husks. The hickory nut is smooth, white and a thinner shelled and sweeter kerneled nut than its cousins. It pops out of a thick, four-parted, smooth husk. The pecan, a very high bred southern cousin of the walnut, leaves its wide-open husk on the tree awhile, when the nut falls. It has a thin, pale, smooth, oval shell and a fine, sweet kernel.

You can easily prove that all these nuts, and the English walnut, are very near relations by cracking them. All of them have two fat, wrinkled seed-leaves, joined through a hole in the middle of a thin partition wall. The leaves are not twin nuts. They are just the two parts of one seed. You know beans and pease seed have two leaves that split when the plant begins to grow. So has the acorn, the chestnut, the buckeye, and the seeds of all plants with net-veined leaves. The forest nuts are the only ones that build partition walls between their seed leaves that the writer ever found. Do you know of any others?

How did the nuts get their hard shells, and their tough or prickly or mossy husks and cups? Just as the apple got its rosy skin, its sweet pulp and its horn-lined seed nests. The shell of a nut is like the seed nest of the apple. It is the hardened covering of the baby egg in the blossom. The cup or husk of the acorn, is really the twig on which the blossom grew. A plant can grow stem and root and bark and leaf and flower, all so very different. So it isn't hard to take a twig bud and turn it into a thorn on the rose, or a tendril on the grape vine, or a cup or husk on a nut tree. Nature is always turning these sleight-of-hand tricks, making the most unexpected things out of anything she happens to have in stock.

For two or three weeks our autumn woods are draped in splendor, and dropping their ripened fruits for squirrels and birds and little boys and girls to find. Then comes a gale of wind and cold rains. Suddenly, the trees are bare, the birds are gone, the squirrels asleep in their cosy store-rooms. The baby leaves and branches and blossoms for next year are tucked up snugly in tiny brown buds, all over the trees. You can find them in early winter, just above the scaly marks left by the leaves that have fallen. Every one of them is a little prize package, rain-and-frost-proofed in spicy gums and fleecy blankets.

Isn't it wonderful that these tender babies, some no bigger than grains of wheat, will be safe and warm even when the ice is thick on the rivers and ponds? Winds that break off great limbs of trees and almost blow you off your feet, will merely rock these babies in their cradles. And under the blankets of leaves and snow, the fallen seeds will lie asleep, as snugly as Johnny Bear in his cave. The first warm days of spring they will wake up, yawn so wide that they will split their shells, stretch their leaf-arms up to the sun, and dig their root-toes into the soft earth.

IV. WINTER: "THE CRADLES WILL ROCK"

Who says there is no use in going to the forests again until spring? What a funny mistake! It's worth while going if only for the pictures in black and white. Many people, who know a great deal about art, like black and white pictures best. They like drawings in crayon, charcoal and ink; prints from etched plates, and fine photographs. The woods, in winter, against gray skies and snowy earth, are delicate etchings. The boy with a kodak, then, is lucky. He can make a whole album of pictures.

Every tree has a character of its own, just as every person has. Don't you know the members of your family and many friends by the way they stand and sit, and carry their heads, and swing their arms when walking? You don't always need to see their faces. You can learn to know trees in that way, too. Their character seems to come out more sharply when they have no soft, colored drapery of leaves to hide them.

The oak tree looks as if its shape was wrought of iron. No two oaks are alike, but all look as if hammered out on some giant forge. Its stout trunk, covered with deeply furrowed black bark, is rooted like a rock. Often it is buttressed, or braced, by great ridges that slope away to outstanding roots. It supports a great weight of thick limbs, irregular and crooked. Clear up to the knotted twigs, and tough brown leaves that often hang on all winter, the oak has a stubborn look. It dares the winter winds to do their worst. And it looks so old, so wise, such a scarred hero of a thousand fights. The old Norse sea kings and the brave English once worshiped the oak tree. It gave them ship timbers that could stand the strain of wind and waves. Many ancient peoples thought dryads, or wood spirits, lived in oak trees.

The elm tree was believed to bless and protect a church or household. There have been many wonder stories written about the elm. It's black trunk, with the bark in deep, vertical ridges, often springs forty feet in the air, straight as a pine, before it branches. Then, from the top, the long limbs sweep, like plumes from a vase. A double row of them makes a high arch across a very wide street. It was often planted for a lucky birth tree when a baby was born. The baby grew up before the elm did, but the tree lived long after

he was gone. His children and grandchildren played under it while it was still a young tree. Elms and oaks often live for two or three hundred years and get their names into history. (See ELM.)

Isn't it wonderful that trees keep a record of their birthdays? Every year's growth is a thin layer of green that, as it hardens into wood, is plainly marked in a ring. The rings are bound together with rays like wheel spokes. When lumber is sawed and polished, the ring and ray marks come out in wavy lines, in delicate pencilings, in curls and "eyes," and color bands, very true to type in nearly all trees. So, in a chair or floor or door casing, you can learn to know the different woods. Grown people know many of these woods in houses and furniture. They know just what each kind of tree is good for.

The Indians knew a great deal about woods, although they could not cut down trees. "Give me of your bark, oh birch tree," sang Hiawatha. He wanted the white, unbroken bark of the big, paper birch tree to cover his canoe with. "Give me of your wood, oh ash tree," he sang. He used the tough saplings of the white ash for the frame of his canoe and for his hunting bow. He knew the best fire-woods, too. He knew that a hard beech log would hold fire all night, that birch splinters made the best kindling, that pine-knots blazed up for story telling, that wild apple wood glowed with rosy flames like its own pink blossoms.

But we are forgetting our winter pictures in black and white. There are other trees with white, or silvery gray bark as well as the birches. Some willows and poplars, the silver maple and the sycamore, a kind of maple or plane tree, have them. And one birch has a yellow bark. You can always tell the birches in winter by the short, brown or dark gray cross-markings on the bark, and by the slender branches and twigs. The willows have many small, drooping twigs but large branches. They often have long, horizontal roots that push the earth up in ridges, and a little forest of switch-like shoots around their feet. The poplars are much like the willows, but their branches are more erect, often growing in so close to the shaft-like trunk as to make these the slenderest trees, except the pines. Switch-like shoots grow about the poplars, and even on the trunks.

In the winter the bark of orchard fruit trees are warm reds and browns and purplish grays, very bright and clean, like wild rose canes. The trunk of an old apple tree may be gray and scaly, but

the higher branches and twigs are bright. It has a low, rounded head. Its stout branches spring from a short trunk, making that comfortable "crotch" where you like to sit with a story book in the summer. The crabapple is small, thorny, flat-topped, a twisted witch of a tree. The pear is tall, slim, with a few thick limbs growing upward and close together. The cherry is wine-red. Its outer bark easily peels in circular bands.

The black walnut tree has a towering trunk that branches high in a beautiful crown. Its bark is as black as the oak and elm, and sharply ridged like the shell of its nut. The butternut or white walnut has a grayish bark and high, horizontal branches. The hickory is a tall, spreading tree with a gray bark that breaks away in long strips. For this reason it is often called the shag bark. The twigs are a warm, yellowish brown, with big varnished leaf buds.

The beech tree has low-hung, wide, spreading branches. Its trunk is a smooth bluish-gray column. Nothing that grows under the beech gets enough sunlight, so the ground is often quite bare. The beech, too, like many heavy trees, braces itself with horizontal roots. It is the best umbrella in the world, in a storm, and it is thought to be the safest shelter, for it is seldom or never struck by lightning.

Bare maples are always graceful. The rock maple is a sturdy, compact tree, with its smooth trunk and rounded head. The red maple has a free, bold way of branching like its five-notched leaf.

Winter is the time of the year for finding bird's nests, for the owners no longer need them. The oriole often hangs its purse of a nest, seventy-five feet in the air, from the limb of an elm. Robins and blue birds are fond of apple trees and maples. Little wood owls like the hollows of oaks. The crow picks out a lofty perch in a cottonwood or pine tree to survey this interesting world. You can find holes the woodpeckers have drilled to drag out grubs, and cocoons tucked away in the ridges of the bark. They hold the baby butterflies waiting for spring. You can tell, too, if a tree is injured or dying. Fungi, or toad stool growths of white or orange fluted ridges, creeping thread moulds, and dry rot around hollows, mean trouble, and decay.

Sometimes, when the Indian boy lay in his wigwam, on a still, cold, winter night, he heard the trees crack. He could not have known what had happened. But now, when sound trees are cut up for lumber, they are often found cracked, across the middle or around

a growth ring. The frost does not harm the smallest leaf-bud baby in its cradle, but it often grips and breaks the hearts of big trees.

Winter is the best time for studying the cone-bearers. Perhaps you call all of these trees pines. Many people do. Only one of their family is a pine, and you would never pick that one out for a Christmas tree. It has long, stiff, needle-like leaves that grow in clusters of from two to five. The clusters grow so close together that they spread in fan-like sprays. The pines, of which there are several varieties, have upright cones of thick, over-lapping, woody scales.

Pines, spruces, firs and hemlocks are alike in having cones and needle-like leaves. Most of them have tall, tapering stems, like ships' masts and telegraph poles. The spruces and firs make the prettiest Christmas trees. The spruce has inch-long needles that bristle all around the stem. In the fir, the needles are flat. They grow on only two sides of the stem, and they slant upward. Sometimes the under side of the leaves are pale and shining. Then it is called the silver fir. The cones of the two trees are much alike, long, slender, with thin, close-set scales. But the spruce cone droops, while the fir cone stands erect. Hemlock needles are short and flat, too, but they lie straight out like the fronds of a feather. The hemlock cones are shorter, with bristling, parted scales. All of these trees have a spicy, balsam-like smell that is very pleasant.

The cedars are very different from the needle-leaved trees. The tiny, flattened, or spiny leaves overlap each other, making scaly or mossy stems. The flat-leaved arbor vitae trees and shrubs are cedars. So are the round-stemmed cypresses, the junipers with their purple berries instead of cones, the gnarly yew-trees with their red or violet seed berries, and the giant redwoods of California. Much like the cedars are the club-mossed larches or tamaracks, that grow in swampy places. Some of the larches and cypresses drop their leaves in the fall.

The cone-bearers put out new leaves in the spring, after their blossoms, dropping the leaves from the older, inner parts of the tree, leaving them quite bare, and strewing the ground with brown needles. All the branches and twigs are tipped with tender green tassels of new leaves. Away up on the tip of the tallest pine is a long green feather. The Indians have a wonder story about that. When a young chief was turned into a pine tree by some bit of magic, he was allowed to keep his eagle feather.

There the feathered tip of the pine waves proudly today, above all the trees of the forest.



FLOWERS OF RED MAPLE.



SILVER MAPLE FLOWER.



SUGAR MAPLE.



SILVER MAPLE.



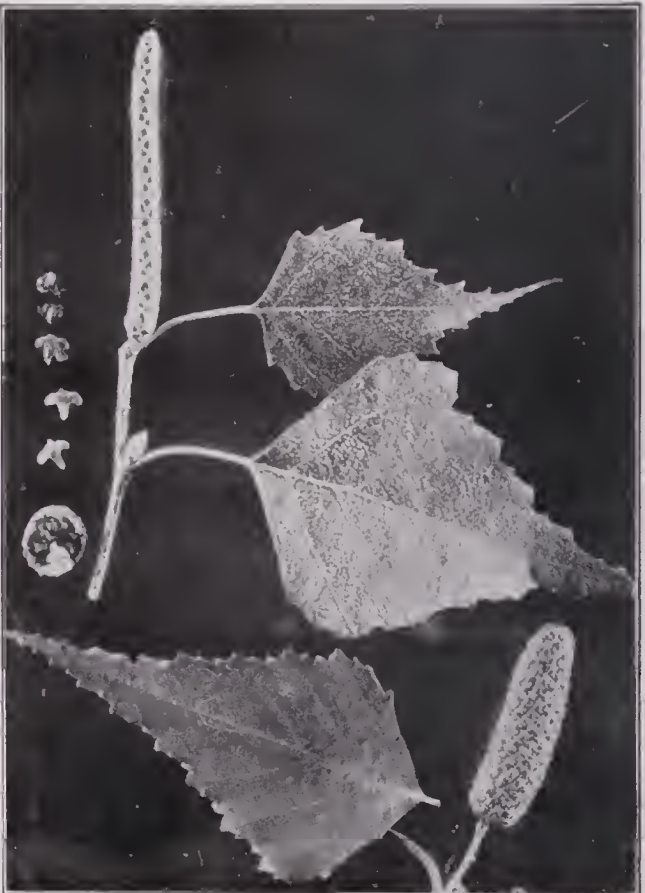
RED BIRCH.



CHERRY BIRCH.



YELLOW BIRCH.



WHITE BIRCH.

PART III—INSECTS, ETC.

I. MRS. MUSCA DOMESTICA CALLS

“Were you speaking of me? Here I am.”

A very dignified little visitor, about a quarter of an inch long, drops “out of the nowhere” in the most surprising way! But she is very polite about ringing a little buzzing door bell to let you know she is coming. “Buzz-z-zip! I’m Mrs. Musca Domestica!”

What a name for such a little creature! One of the capital letters of it would almost cover her, and the length of it would make a nice distance for an evening stroll.

“It’s just Latin for House Fly,” she says. “Don’t you think I deserve it? I come into the house whenever you leave the screen door open. I’m neighborly and don’t wait to be invited. I’m very fond of human society. You have such nice things to eat. But you are not very friendly,” she added reproachfully. “Actually, I’ve had the door shut in my face, and been ‘shoo-ed’ out like a hen.”

“Well, you’re not very clean, you know. You go to dirty places, and you don’t wipe your feet.”

“I would if I had a door-mat, I would, indeed. I wash my face and brush my clothes oftener than you do. Just watch me.”

There she sits at a respectful distance, rubbing her little front hairy legs together vigorously. Then she balances herself on the other four, and rubs the hindlegs.

When the middle pair are cleaned, she draws a leg across her mouth to wet it, and washes her face like a cat. Finally she flutters her silver gauze wings to shake the dust off. As a delicate hint she nibbles at a clean plate.

“Don’t human people ask their visitors if they care for refreshments? Thank you! A grain of sugar is my favorite lunch. You may watch me eat, if you won’t come too near.”



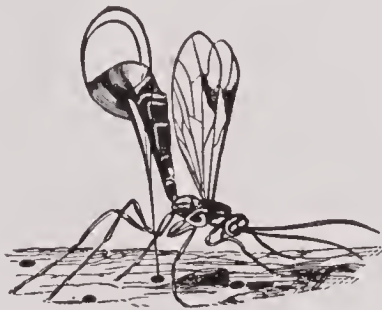
A house fly magnified.

She has no legs to spare for picking up food; but she has a little mouth that drops like an elephant's trunk. Out of that mouth comes a dew-drop of liquid to make syrup of the grain of sugar. The knob on the end of the mouth parts, and the two lips spread out flat over that drop. She stands there licking with a little rasp of a tongue blissfully until she has sucked it all up. Then she wipes her mouth with her foot, and cleans herself all over again.

"I have another name. It's Diptera. That means two-winged. My family is very important. It's the biggest one on earth, with thousands of members. You can always know a Diptera by the two wings. Most insects have four. One of my cousins is very musical, but I am sorry to say, he is also a blood-sucker. If he shows any fondness for people, it's because he likes to bite them. His name is mosquito. The horse-, or gad-fly, can make horses jump and even run away. The Hessian fly stings wheat. The saw fly lays her eggs on rose blossoms. The tsetse fly kills cattle sometimes; the gall fly stings plants and makes galls grow on them. And there are gnats and midges. They come in swarms. Did you ever hear of 'a plague of flies?'"



Tsetse Fly, found in Africa. Its bite kills cattle, horses and dogs, but is harmless to man.



Ichneumon Fly; is useful because it destroys insects which injure trees and shrubs.

"Yes, indeed, and 'the fly in the ointment.' You spoil a good many things. Your whole family seems to be a nuisance."

"Not all. The dragon-fly and ichneumon fly are useful. And I don't see what you have against me! I can't bite or sting, and I eat very little, compared with some people I could mention. To be sure, I have little tickly hairs on my feet and scrapers on my tongue, and that makes people nervous. And I like to wake lazy people up in the morning. No one can sleep after daylight when I'm around. If you had only one summer to live, you'd want to get up early and make the most of every day.

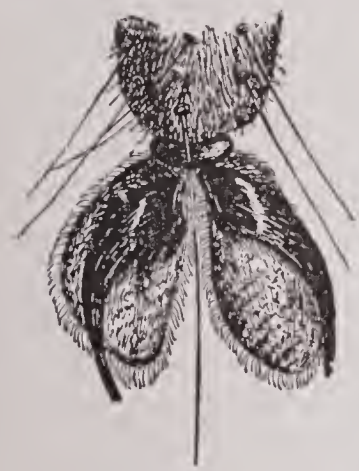
"It's pretty hard to catch me, too. I have several thousand little flat eyes in the two in my head. They're like the facets on a

diamond, only ever so many more of them. I can feel, and I can smell food with these two feather plumes on my head.

"No, indeed, I *never* fold my wings, when I sit down, as foolish moths do. I keep them ready for business. Aren't they pretty? I make them of silver gauze, and paint them with bronze and purple. Do you notice cream-tinted scales behind them? Those are balancers. If I didn't have them I'd tumble head over heels when I tried to fly. I can tilt my head, too. It is set right down on my shoulders, on a kind of pivot.

"No, I never have dyspepsia, thank you! You see, I make syrup or broth out of everything I eat. The food goes into a little mill, with spiny teeth, to be chewed and mixed with something to digest it. Then it goes into a little bag of a stomaeh. I can tell you how not to have lung troubles, too. Don't have any lungs. I breathe through holes in my skin like the leaves on the trees. I fill little air bladders and pass the air back to blood vessels.

"If you really want to know how wonderfully I am made you ought to have a glass that would magnify me a hundred times. I



A fly's foot magnified.

have three silver girdles across my chest, or thorax, a yellow band on my abdomen and some golden spots. All six of my legs are fastened to the thorax. But if there is one thing I am vain of it's my feet. Just look at them. The legs are jointed, and on the last joint of each is a pair of claws like a lobster's. But they close over a pad or cushion covered with knobby hairs. All those hairs are sticky, and cling to things. Really, the smoother you make your walls the better I like them.

A gold picture frame, or a nice white gas globe just suits me for an evening stroll, or a bed to sleep on, upside down. But every thing sticks to those feet! I can't keep them clean, although I wipe them on every bit of bread or food you leave out for door-mats."

"Ah, so that's why you bring typhoid fever into the house, naughty fly!"

"Well!" with a little bristle of wings. "No wonder! You ought to see where I have to bring up my babies. I can't carry them around, all legs and no arms as I am, now can I? I have to lay my eggs in warm moist places around stables and in garbage cans, or

they never would hatch or have anything to eat. You never see those eggs. They are dull, chalky seed-looking, little things, buried in smelly places. They hatch out into little white squirmy larvae in twenty-four hours, and eat that decaying stuff. I wouldn't touch it myself! I like the good things on human tables. In less than a week those babies grow as long as I, and shut themselves up in brown cradles.

"Asleep? You wouldn't think so, from all the things that happen in a week's time. Why, they make themselves all over, from little white, crawly, unpleasant grubs into—"

"Beautiful little winged creatures like their mother?"

"Not just at once. When they push the front ends of their cradles off and crawl out, their wings are very small and soft and baggy, and cling close to their sides. Those infant flies are pale and sickly looking. You wouldn't think them likely to live. And they breathe by puffing out their foreheads in the most comical way. I assure you I don't always know my own children.

"Do I have many children? Oh, quite a few. I never keep any account of them. I lay something near a hundred eggs at a time and four times in a season. In just fourteen days after an egg is laid it is hatched, eats, grows, makes a cradle, comes out and is a full-grown fly ready to lay eggs itself. I shouldn't wonder if I would be several times a great grandmother before I die. I'm not saying it to brag. It's a trait of the whole Diptera family."

"Mercy, no wonder there are so many of you!" Mrs. Musca Domestica rubbed her clothes brush legs together, thoughtfully, and washed her face for the third time.

"There are not as many house flies as there used to be. We really threaten to die out. People don't leave as many piles of refuse about for us to lay eggs in. They scald their garbage cans, put lime in plumbing traps, and actually wash stable floors with hose. There are screen doors and windows everywhere. If we do get into a house, there are fly traps and sticky paper to catch us. In some houses there isn't a crumb about. I really wonder such stingy people don't starve themselves. We have other troubles, too. Most of us die of a kind of fungus that paralyzes us, in the fall. Haven't you seen us sitting around, unable to move, with gray bands around our bodies? A few of us do manage to creep into cracks of warm houses, and go to sleep until spring. And there is—

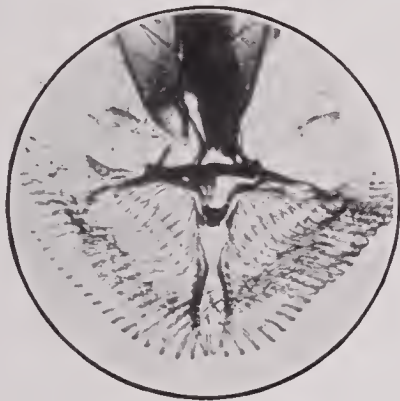
"Did you say spiders? ? ? "Good-by! ! !"

See FLY, page 687.

HOW A LITTLE FLY STARTED A BIG WAR



This picture shows Professor C. F. Hodge, inventor of the fly trap, and a heap of dead flies, of which sixteen million were caught in the campaign he conducted in Worcester, Massachusetts.



These fly traps were used on garbage cans and kitchen tables.

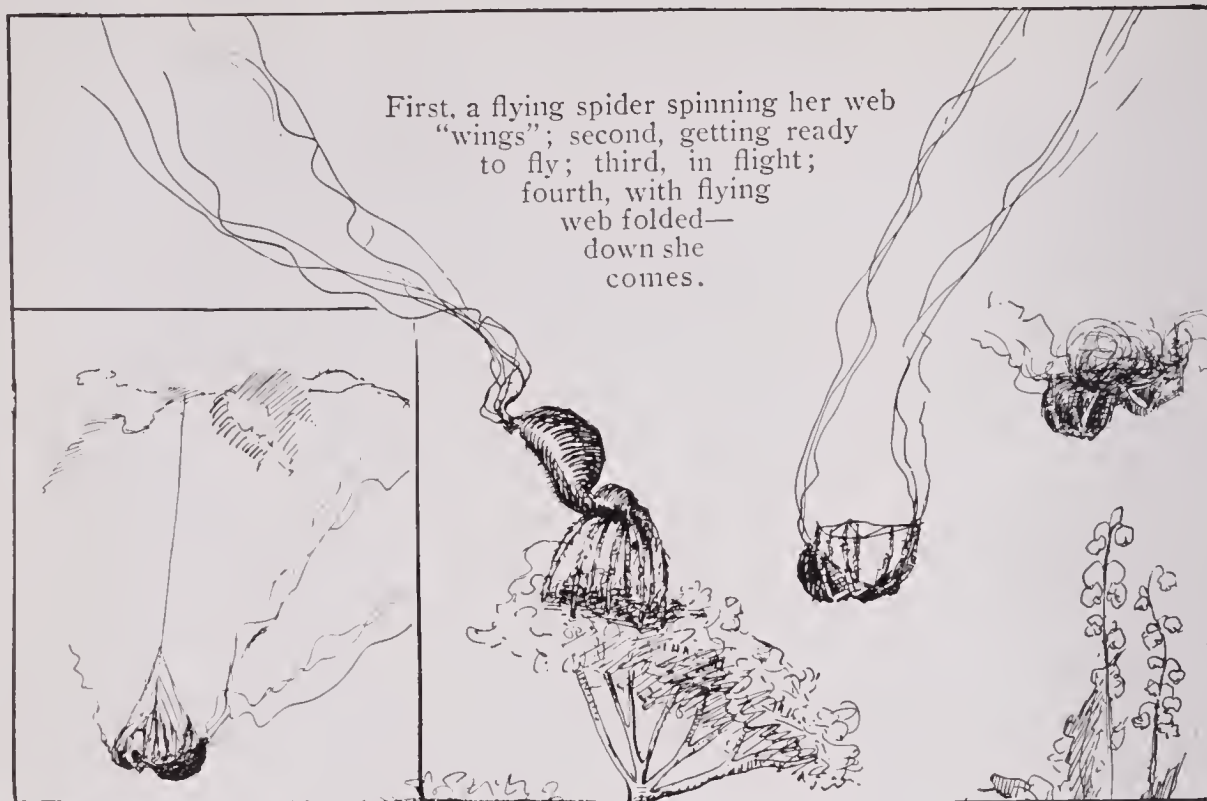


Next to the "heap of the slain" before which Dr. Hodge is standing is a picture of a fly's foot and below it, in the circle, a fly's tongue as they look under the microscope. It is with his unclean tongue and feet that the fly spreads disease.

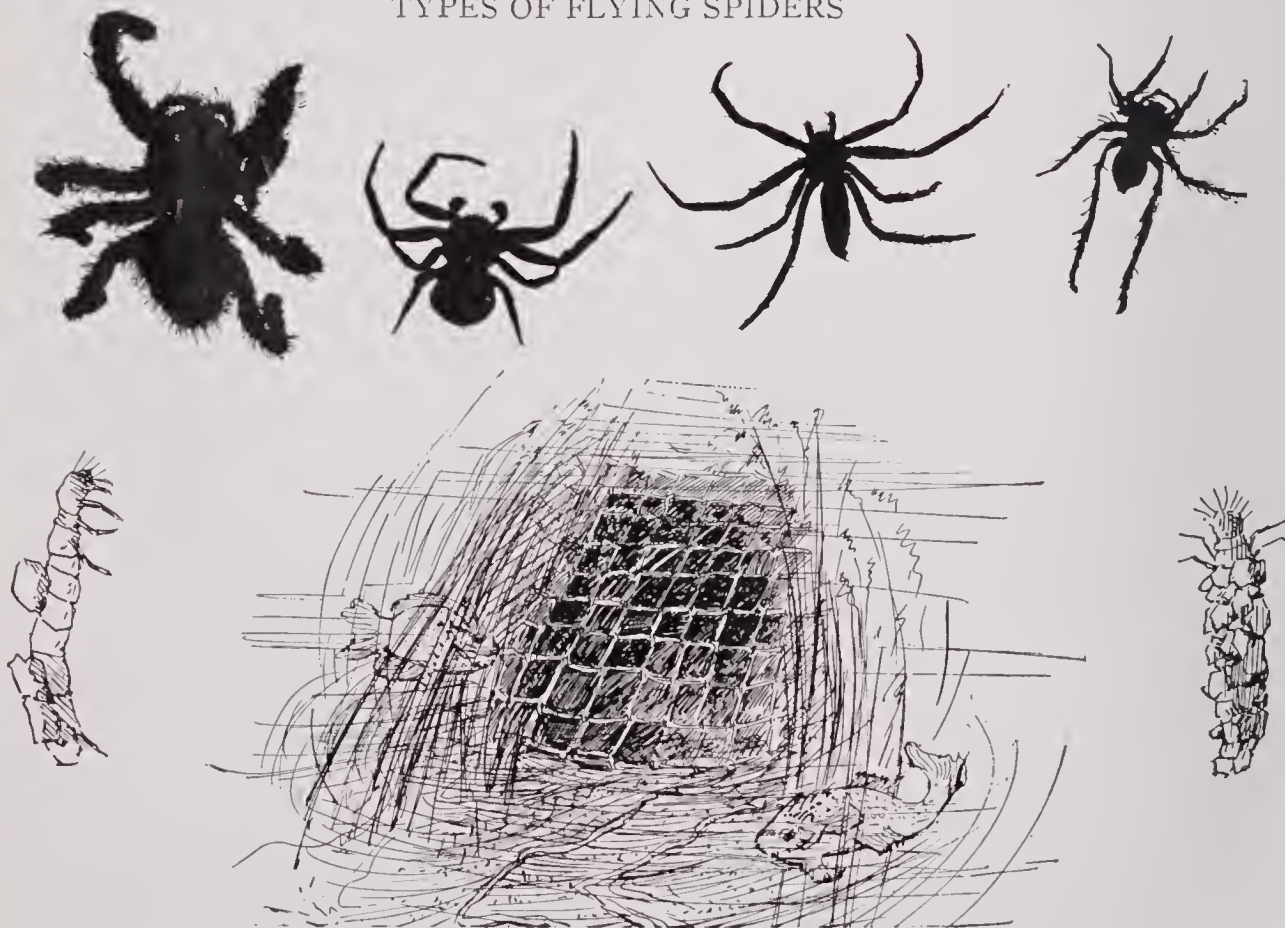


The great city of Cleveland, with the help of the newsboys and the school children and Dr. Hodge's fly traps, got rid of its flies in one season. The city paid ten cents a hundred for dead flies and as many as 25,000 were bought in an hour.

WEBS FOR FLYING AND FISHING



TYPES OF FLYING SPIDERS



Strange little spinner under the water! This is the caddis worm—larva of the caddis fly. She spins a silk tube and across the entrance a web (here greatly magnified) with which she catches little water people, as spiders catch flies. When outside of her "suitcase" she drags it about with her. Small shells and gravel stick to her and her case.

II. MRS. GARDEN SPIDER "AT HOME"

Mrs. Garden Spider won't come to see you and buzz by the hour. If you go to see her she'll tell you plainly that she doesn't care for society. It takes all her time to build her house, earn her living, and bring up her babies. She isn't asking favors of anyone, and she'll be obliged to you if you won't stand around and scare flies away.

But she makes such a pretty house that you feel like going anyhow. It's a gossamer wheel of a curtain. You can find it in almost any garden, stretched across a fence corner, or between the low branches of stout shrubs. You won't often see the little gray and brown mistress of it. That house is merely a sun-parlor of a net, spread in the open for the unwary fly. The lady of the house is of such a retiring nature that she prefers to live in a dark tunnel den behind the parlor. Stand out of sight—and remember Madame has from two to eight eyes in her head, and can see all around the compass—and fling a bit of dry leaf on the web. She darts out. She views that leaf with disgust, thinking the wind has played a trick on her. Very likely she will push it overboard, for she keeps her house clean and shining.

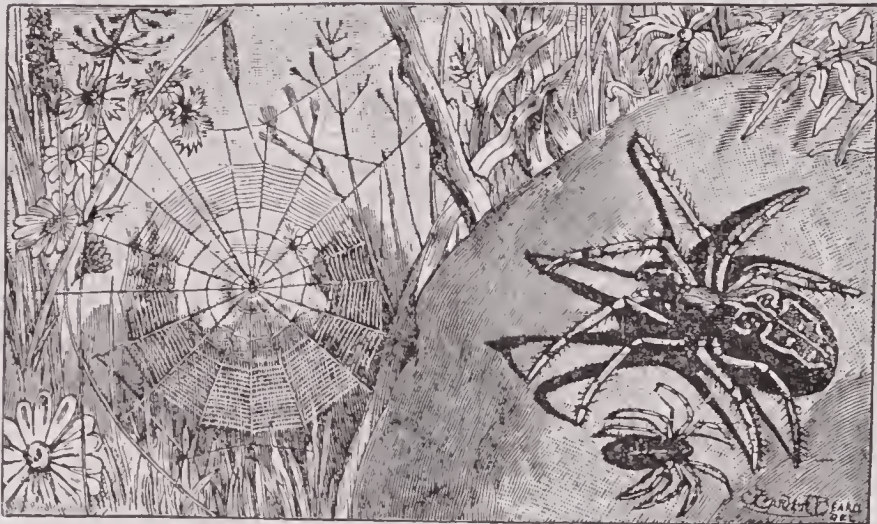
Any time a hard rain or wind comes along the pretty house may be wrecked. Then you may watch Mrs. Spider build it again. She has to do it before breakfast, too, or go hungry. Get an opera glass, if you can, and watch her at a distance. She sits out on a leaf or twig or fence post, looking over the building site. The color of dead wood, half an inch long, with eight thread-like legs, and darting movements, she isn't easy to follow.

She drops, or jumps, from one support to another, paying out a tiny, gray silk cable behind her, and fastening it wherever she can. Soon she has an irregular space inclosed. Do you know how fine those lines are? You would have to lay four or five thousand of them side by side, to make a ribbon an inch wide. You can see her run around those lines and pull them with her hind foot to test their strength. If one breaks she spins another.

She jumps, or drops, across the space, carrying a line, and fastens it to the farther side. She runs back to the middle, doubling the line as she goes, and jumps across at right angles. Soon, she has her space cut into four equal parts, as neatly as mama cuts an

apple pie. Then she cuts each piece in two, once and again, making eight, then sixteen pieces. Those are the spokes for the wheel web. The many crossings make a stout hub. She tests the spokes, pulling on each one and running over them. She has three claws, and fine-toothed bristle combs on her hind feet. May be she combs the snarls out and brushes away dust.

Back she goes to the hub and weaves a spiral line, crossing the spokes and gluing the joints. She does it much as your mother



SPIDER AND ITS WEB

makes a spider wheel in lace work. After a few wide turns, she makes the crossing circles closer together, because the spokes flare farther apart. She doesn't fill in all the space out to her foundation lines. Some building sites are larger than others. She takes the best one she can find, but her web is always about the same size.

Finished? No, indeed. When men build houses they first put up the frame work, then cheap scaffolding to stand on. Mrs. Spider sets up scaffolding to walk on. She starts back from the outside edge of the wheel. This time she uses a much better silk. It is studded with little sticky beads. You heard Mrs. House Fly say she liked smooth things to walk on, didn't you? Gummy spider webs tangle in the hairs on her feet, and hold her for an instant. Mrs. Spider knows that very well. Her web is a very good sticky fly paper. As she travels back to the hub, she cuts the scaffolding away. Then she makes a silk den behind the web, and connects the web and the den with a telephone, or door bell wire, that she keeps her foot on. That web is stretched like a drum-head. When a fly drops on it, it vibrates,

Wonderful, isn't it? And it didn't take Mrs. Spider more than an hour to make it. If it is destroyed she seems to have plenty of material to build another. It really is *Mrs.* Spider who does all this work. You will nearly always find her living alone. Mr. Spider is very much smaller than she is, and he is not a worker. As the female bees do all the work, and drive the drones or males out of the hives, or even kill them, so Mrs. Spider barely tolerates her mate and even eats him if other food is scarce. She builds her own house, catches her own food, looks after her babies, and lives all alone in a busy solitude.

A long, long time ago the work of this clever spinner and weaver was looked upon as pure magic. The Greeks made a wonder story about her. The spider was a maiden named Arachne (A-rak'ne). In a contest of spinning and weaving she proved herself better than the wise goddess Athe'na. To punish her for daring to be more clever than a goddess, Arachne was turned into a spider, and told to spend the rest of her days making her wonderful web. Unable to talk, Arachne kept the secret of her spinning until men made microscopes. Now, it seems as if this little creature could always have told men how to make spinning frames to turn cotton, silk, wool and flax fibres into yarn.

At the rear end of her abdomen are from two to eight little pin-head knobs, in pairs. These are spinnerets. Each one is covered with hollow bristles. Altogether there may be a thousand of them. From each one comes a hair of liquid silk. They all flow, or are twisted together into one thread. The spider seems able to expel, or shoot out, the silk and fasten it to any support, and to use the lengthening cable to propel herself. Haven't you seen house-spiders let themselves down from ceilings by these silk cords? Once started a web thread seems to be pulled from the spinner as fast as she travels.

The spider is not an insect, as are the fly, the ant, the bee and butterfly. She has eight legs, while insects have but six. Her body is in two parts instead of three. Her legs are jointed like a lobster's, and like the lobster and crab she is a fierce fighter, and hunter. If a leg is torn off in a fight she is usually able to grow another one. She has no wings to fly, but is a regular acrobat, doing high jumps, and long leaps, and tight-rope walking and cliff-climbing up smooth walls. You see, she has eight legs, each one with seven joints. Seven times eight are fifty-six joints, and all of them are as limber as a trapeze performer's. The spider's jaws are steel traps with biting

teeth, and behind them are little poison sacs. Few spiders could hurt you seriously, but their bites paralyze flies and other small insects.

From the two to eight little eyes in her head, to the same number of spinnerets in her tail, from the deadly jaws to the sensitive, clawed and bristled and padded foot, the spider is a wonderful little creature. She is as clean as Mrs. Fly, washing her face and brushing her hairy body and legs vigorously. She keeps her web clean and every thread mended. And she cares for her babies as tenderly as a mother bird.

Did you ever see a garden spider moving along slowly, dragging a little gray silk ball with her last pair of legs? That is the cradle she makes of silk for her eggs. It isn't fastened to her. When at home she keeps it in the den, or hangs it on a nearby twig. But when she travels she takes it with her, although it hampers her, and makes it much easier for a toad or frog or bird to snap her up. If she drops that ball she hunts for it frantically. Her babies are not hatched out as greedy little grubs, but as little specks of spiders. That is quite unlike any insect. And Mrs. Spider carries her babies on her back. They just swarm all around her like chickens around a hen. She must have to feed them at first, much as a robin feeds its nestlings.

Don't kill spiders in gardens. They eat insects, oh, a great number of them, for they are big eaters. Nearly all insects are harmful, or their grub babies are, living, as they do, on plants. The spiders' wheel and sheet webs, and tunnel dens, are very wonderful. The little creatures are patient, skillful and industrious as bees and ants. They neither use nor destroy anything useful, and they help us grow flowers and vegetables, by eating the flies and moths that lay their eggs on plants. See SPIDER, page 1798.

III. GULLIVER MAN AND HIS LILLIPUTIAN ENEMIES

Once upon a time a baby was born. It was a very, very small baby, and almost too feeble to move. Yet, the very first day of its life, it ate two hundred times its own weight. As long as it lived it ate as greedily as that. It was nearly all mouth and stomach. Every day or two it outgrew its own skin. The skin split down the back, the baby crawled out in a new and larger skin, and went right on eating. It seemed never to sleep. In a few weeks it changed its skin five times. When it was grown up it was ten thousand times as big as when it was born.

What a monster! If this were a human baby, it would have eaten a pile of food as big as a ton of coal the first day. And, when fully grown, it would have weighed one hundred thousand pounds. Is this a giant story, like that of the Brob'ding-nag'ians in Gulliver's Travels? No, it's a really, truly story, but the monster babies are more like the Lilliputians. They were the tiny people, who swarmed all over Gulliver when he was asleep, and tied him up tight with cobwebs or something. Our Lilliputian enemies are caterpillars and grubs. They are hatched, many of them, from pinhead eggs, and they grow to hundreds and even thousands of times as big as when they come out of the eggs.

"Once upon a time" is right now, and all the time. You can find these monster babies on every lawn, in every garden and park and farm, on the grass, on small plants and big trees; buried in soft fruits and hard grains, and in tunnels they have bored in roots and stems and tree trunks. You can see their fathers and mothers flying in the air, too. They are beautiful butterflies and moths, shiny beetles and gauzy-winged flies. How pretty they are, and they don't seem to be doing any harm at all.

So long as they have wings few insects eat much, and most of them live only a short time. But the females are busy laying eggs. That little gray moth, half an inch across the wings, that you see hovering over the pink apple blossoms, lays an egg that hatches into the apple worm. The fat white grub eats its way through, spoils the apple and crawls out. It spins a rough cocoon, just the color of the tree, and under a scale of bark. There it lies all winter, coming out as a moth, in the spring, to lay more eggs in the blossoms, to spoil more apples.

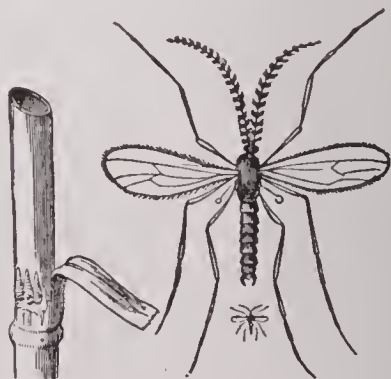
All insects go through this larva stage. Then they do nothing but eat. Bees feed their babies with honey, so they do no harm at all, and are very useful to us. But most insects die when they have laid their eggs, and they leave their greedy babies to eat plants that men work so hard to grow. They always lay the eggs where the larva can find their favorite food, and they lay hundreds and even thousands of eggs, most of them too small for you to see.

When the eggs of butterflies, moths and flies hatch, they come out as caterpillars with six legs, hairy or smooth worm-like bodies and chewing mouths. The larva of beetles are usually footless grubs. Some of them look much like the parent insects, but are less active. They all begin to eat ravenously. Inside there is little but stomach and material for making cocoons. Leaf-eaters grow to full size in a few weeks. Orchard fruit and nut eaters stay in the fruits until they fall. The larva of some boring beetles live in the wood of trees for two or three years. They honey-comb solid trees with little tunnels.

When grown to full size the larva of all insects spin cocoons or make horny or papery cases. Some roll up in leaves, using a very little silk to close the openings. They use the hairs from their own bodies, sometimes, to mix with silk, or with plant fibres. These cocoons nestle in the ridges of bark, hang from stems or leaves, or lie in the ground. Cocoons are often so near the color and texture of the thing they are fastened to, that you may look at hundreds of them and never see them at all.

There is no living plant or animal that these little creatures do not prey upon. As insects they sting, suck blood and sometimes kill the higher animals. But it is as grubs and caterpillars that they eat and injure millions of dollars worth of grains and fruits and garden crops every year.

Wheat has three insect enemies—the chinch bug, the Hessian fly and the wheat midge. When ground into flour the meal worm often hatches out and makes it unfit for use. On the potato plant is the Colorado beetle that eats the leaves, so they cannot make plant food. The cabbage head is burrowed into by the larva of the cabbage moth. Big green caterpillars feed on the tomato, and grape vines. A moth makes

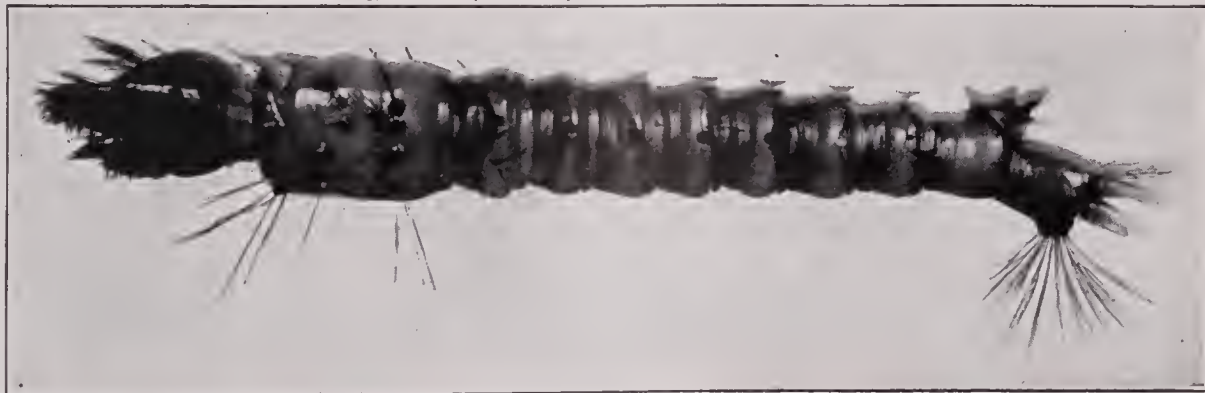


Hessian Fly which causes great damage to wheat.

OUR WAR WITH THE MOSQUITO



First picture shows head, feelers and lance of female mosquito; on the right, "whiskers" of male mosquito, supposed to be an organ of hearing; in the center, a doctor's outfit for catching swamp mosquitoes for study.



Mosquito larva wriggler. (Greatly enlarged.)



Mrs. Mosquito's surgical instruments—a lance and four little saws.

wormy apples and pears, but the curculio, a weevil beetle, punctures the skins of plums, cherries and peaches, and pushes an egg down to the stone. The currant worm strips the bush fruits of leaves. The slug of the saw fly destroys roses, and little, green, plant-lice, or aphides, suck the juices of rose bushes, fruit trees and hop vines.

Cotton plants have three enemies—the cotton-boll weevil, the cotton worm, hatched from a moth egg, and the cotton stainer, a little red beetle. The chief enemy of corn is the cut worm. The army worm marches from field to field, millions strong, destroying



Cotton-boll weevil; first figure showing insect at rest and second showing wing-covers lifted and wings extended for flight.

grasslands. Grasshoppers come in clouds and leave bare fields behind them. On the bark of fruit trees a leech of an insect sucks unseen, under the black speck disc of the San José scale. The tree dies and the pest spreads through an orchard. The tent caterpillars often take entire limbs of fruit and shade trees. They weave a cob-web tent over a big colony of squirming leaf-eaters.

The number of species, or kinds of insects is far, far beyond all other living creatures put together. Some scientists say there may be a million species. They all lay countless eggs. One scientist says that a young cherry tree may have ten million plant-lice on it. In one year the codling moth has put worms into ten million dollars worth of apples, and the Hessian fly has destroyed one hundred million dollars worth of wheat in our country. All the insect pests put together cause a loss on our farm crops, orchard fruits and garden products of five hundred million dollars in some years.

Isn't it a wonder they leave anything at all for human beings and the higher animals to eat? Farmers and gardeners fight these enemies all the time. They spray plants and trees with poisons. They plow land in the fall, to turn up buried cocoons to the frost. They plant trap strips to catch the larva, and burn the strips. In gardens they pick off grubs and caterpillars by hand. They cut

down trees and limbs and burn them. All the year around these enemies, too small, often, to be seen, too high to be reached, too hidden in the earth, in the fruits, the bark, the hearts and roots of plants, to be found, are fought. But all that human beings can do, is to keep them in check—sometimes. And sometimes men can only look on, quite helpless, and see fields laid waste. Don't you think farmers must often feel as Gulliver did, when he was bound by those swarms of five or six inch high Lilliputians?

If men had no help in fighting these billions of enemies they would lose the battle. But these greedy little creatures have enemies of their own, that live among them and prey upon them. These enemies of the insects are our friends. Do you know any of them?

Birds? Oh, yes, of course, all the song birds. We will tell you about our bird friends in another story. But there are some useful insects, too, that live on their kind, and a few other humble creatures that you may think of as pests. Perhaps, not knowing, you may have killed some of them. You ought to know all these friends so you can protect them, for we need all the help we can get in growing useful plants and animals. To help you understand just how powerful and destructive these insect enemies of ours are, turn back in this book to the names of some of them. See INSECTS, CATERPILLARS, BUTTERFLY, BEETLE, FLY, WEEVIL, NATURE STUDY, APHIDES, ARMY-WORM, CODLIN MOTH, COTTON-BOLL WEEVIL, CANCER WORM, CHINCH BUG, HESSIAN FLY, GRASSHOPPER, LOCUST, SLUG, POTATO BUG, "FRIENDS IN FEATHERS."

IV. PYGMY FRIENDS THAT FLY AND HOP AND CREEP

Lions and tigers are such terrible beasts that you are very glad they live in circus menageries, park zoos and far-away jungles. As for dragons, very likely they never lived at all, except in story books, along with mermaids and jobberwocks. But insects could tell you quite a different story. In their world, up in the air, down on the ground, in earth dens and even in the water, are beasts of prey that devour them. The very names of some of them are enough to frighten their victims into spasms. There are dragon-flies, ant-lions, tiger-beetles and spiders. But some of them have quite innocent names, such as frog, toad and lady-bird.

Wouldn't mosquitoes and flies and gnats be indignant, if they knew that we think the dragon fly beautiful? But it is as beautiful as any butterfly, and in its darting, skimming flight it is as swift and graceful as a swallow. It really is the swallow of the insect world. It catches and eats its food on the wing, and it eats nothing but flying creatures smaller than itself. It hunts its small game over ponds and ditches, swamps and marshy shores, just where insects breed by millions. Very likely you call these pretty friends of ours snake feeders and devil's darning needles, but they are too busy feeding themselves to feed snakes, and they can't sting or bite you or sew up your ears, at all. They are as harmless as humming birds.

There are several varieties of dragon flies, darners and damsel flies, but they are all insect feeders. They have very long, slender, stiff bodies of dazzling metal colors, in steel blue, purple, green bronze, copper and silver white. Their four long, narrow, silver-gauze wings are beautifully veined, and are often spotted with white or brown or amber. Their big, jewel eyes stand out from their heads and glitter like automobile lamps. And they have regular snapping-turtle mouths.

On very hot midsummer days there often seems to be nothing on the wing but these glitter-winged dragons of the air, and their swarms of little victims. Some of them skurry to shelter in the water weeds if a cloud blows up, but others love to frolic with the wind, and will even go out over white-capped waves on the sea shore. If food is scarce on the water, some of them will go up into meadows and orchards and get a lunch of codlin moths and weevils.

The green-bodied darner even ventures onto lawns, and eats house flies and mosquitoes there.

When dragon flies alight, which isn't often, for they seem tireless, they keep their wings outspread. The damsel flies fold their slender wings down their darning-needle backs, in the shyest way, as if they didn't want to be noticed. Their name comes from the French—*demoiselle*—which means young lady. One of the damselflies is so gray and modest that it is called marsh nun.



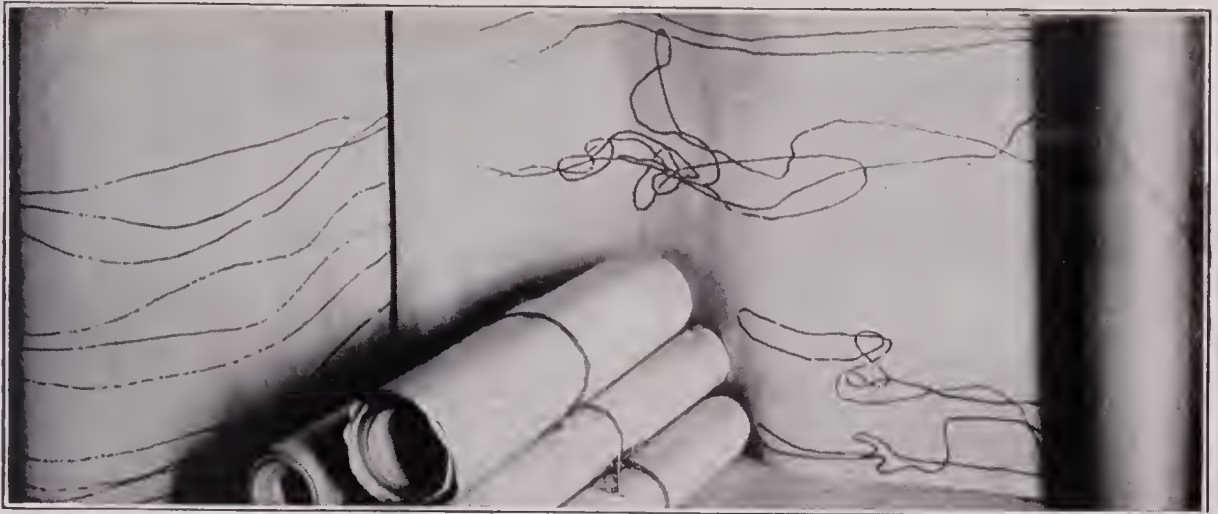
All these are insect feeders, both in the winged and in the larva stage. They lay their eggs on the water, or on the stems of water plants. The larva are not worms or grubs, but imperfect insects something like grasshoppers. They are called nymphs. But you will never see them. They live in the mud and on stems in the water, and they eat tadpole mosquitoes, and other water larva.

Dragon Fly. It has no sting and is harmless to man. It feeds on insects which it catches while on the wing.

There is another insect something like the dragon fly that looks as if it might sting. It has a long, wire-like tail that it can curl over its back and poke into a hole in a tree. This is the ichneumon fly (ik-noo'mon). It often stands on the bark of a tree exactly like a woodpecker, so motionless that you can snapshot it with a kodak. It has very long, jointed legs and feelers, and one kind has a body that flares out behind like a brass horn. Some people think the ichneumon fly bores those holes in trees. But the hole is made by some boring beetle. At the bottom of each hole is a grub that feeds on the wood. The body of that soft, fat grub is just the place the ichneumon fly likes to lay an egg in. Then, when the baby hatches, it eats the grub. The fly will go all over a tree and poke its flexible wire egg-layer into countless holes. This clever creature eats very little, but spends most of its time laying eggs in the larva of moths, butterflies and beetles.

Sometimes you may see an insect that looks like a small dragon fly, but that flaps its four gauze wings, in flying. It lays eggs in tiny sand deserts in the woods, on river banks and sea shores. An innocent looking flier it is, but its larva is a true beast of prey—the cunning,

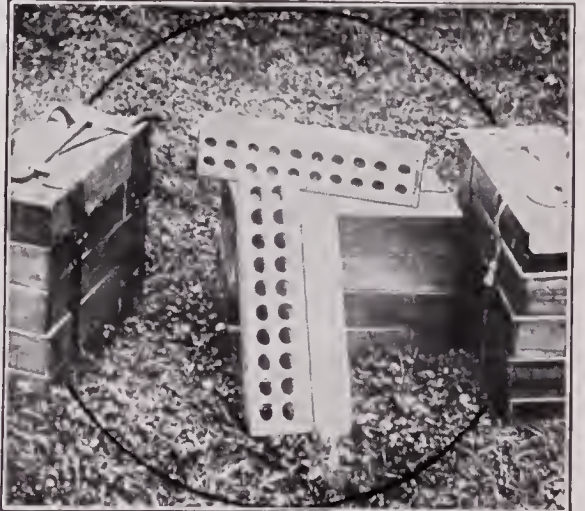
A PIGMY FRIEND "WROTE" THIS



A beetle grub traveled $1\frac{3}{4}$ miles on these paper rolls. He was kept "inked" like a pen and so wrote his own record.



Such beetles are imported by our government because they live on destructive caterpillars, and the above record was made to learn how far they could travel in search of food. They were brought from Europe in these match boxes. On the right is a beetle breeding house.



The picture on the left shows glass jars of earth containing eggs of these beetles hatching in the sun; on the right, how beetles are carried into the field for planting colonies. Every hole is the house of a beetle.



NEST OF GRASSHOPPERS UNDERGROUND.

The eggs of these insects laid on the ground, hatch out into larvae or grubs which burrow in the ground, and when developed the insects crawl to the surface.



NEST OF BEETLES UNDERGROUND.

flesh-eating ant-lion. The egg hatches into a clumsy, humped, bug-like creature, with spiny hairs to which wet sand sticks. It has six digging legs, and jaws like a mouse trap. It makes a round pit about as big as would be made by pressing the bottom of a small teacup into the sand. When an ant or other little creeper runs over the edge of the pit, it just naturally slides down hill. Before it can climb out again it is snapped up by the half buried ant-lion.

Another sand-dweller with a lair is the tiger beetle. It is brave in a shiny armor of copper, golden green, sand color or pea green with white spots, and is striped and spotted like a tiger or leopard. Its jaws are long, horny, hooked and toothed, and they shut together like the blades of scissors. The larva of the tiger beetles dig pits in which they lie, mouth and eyes out, snapping up all small insects that come their way.

Did you ever catch a pretty red, black-spotted lady-bird beetle on a rose bush, and say:

Lady-bird, lady-bird, fly away home.

Your house is on fire, your children will burn!

It fairly leaped in wild alarm, when you let it go. Lady-birds cannot walk well, so they are easily captured, but they can fly. There are black lady-birds with red or yellow spots, too. Do you know why you can find them on rose bushes and fruit trees? They eat those little soft green plant lice, or aphides, that swarm on certain plants. In England gardeners hunt for these neat insects to put into flower gardens, orchards and hop fields. If they couldn't get these little friends in any other way, very likely they'd be willing to pay for them.



LADY-BIRD

French gardeners really do pay four and five cents a piece for ugly, warty little hop toads. Toads eat almost anything—red spiders, flies, wasps, caterpillars and moths. And they just dote on cabbage and green salad worms. Nothing touches the toad. He has no teeth to bite, or claws on his webby feet to fight with, nor a stinger. But he has glands behind his jewel-like eyes with which he can make a dreadful smell. This liquid doesn't cause warts as some people think, but it gives the toad a nice wide field of lonesomeness. He is a night prowler, coming out at dusk. In the daytime he sits in a shady place taking a mouthful of air at a gulp, now and then.

The toad, like his water cousin, the frog, has a long tongue, fastened to the front of his jaw. It unrolls, darts out like lightning, catches an insect on a gummy tip, and snaps back quicker than a wink. A toad can clear a house of cockroaches, and a few in a garden will give you more sound vegetables and fewer worms. Tree toads are useful in forests and orchards, and frogs in ponds and swamps. The garden spider is useful, too. (See MRS. GARDEN SPIDER "AT HOME.")

There is another very humble, helpless little friend that you should not harm. This is the smooth, pinkish-brown worm that you dig for fish bait. It is a true worm, and not a caterpillar or larva of an insect. Its real name is earth-worm. It eats earth for the water and decaying vegetables, but every bit that it eats passes through its soft body, and is powdered and enriched so it will grow plants better.

After a hard rain you may see sidewalks strewn with their dead bodies. They cannot live without moisture, but too much rain often drowns them out of their burrows. If a living worm is touched it shrinks to half its six or eight inches of length, which shows that the little blind creature can feel, and be afraid. Then you can see that its body is made up of ring muscles. And under a magnifying glass you can find tiny hook-like feet, and a sharp gimlet of a boring nose. That nose bores through and through the soil. One worm, it is said, can turn up a quart of finely powdered earth in a summer. And it must turn up many insect eggs and cocoons, to be eaten or to die. Earth worms is one sign of good soil. When the soil is naturally poor, or is worn out by bad farming, there will be few earthworms in it or none at all. (See DRAGON-FLY, ICHNEUMON FLY, FROG, TOAD, LADY-BIRD, EARTHWORM.)



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FROM BIRD GUIDE © CHARLES K. REED, WORCESTER, MASS.

COMMON BIRDS IN THEIR NATURAL COLORS

Song Sparrow
Wood Pewee
Kingbird
Scarlet Tanager

Rose-breasted Grosbeak
Phoebe
Cowbird
Bobolink

Wilson Thrush
American Redstart
Purple Martin

Blue Jay
Catbird
Indigo Bunting
Orchard Oriole



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FROM BIRD GUIDE © CHARLES K. REED, WORCESTER, MASS.

COMMON BIRDS IN THEIR NATURAL COLORS

Flicker
Bluebird
Yellow-bellied Sapsucker
Chipping Sparrow

Cardinal
Belted Kingfisher
Cedar Waxwing
Red-eyed Vireo

American Goldfinch
House Wren
Wood Thrush

Red-breasted Woodpecker
Oven-bird
Red-winged Blackbird
Humming Bird
Meadow Lark

PART IV—BIRDS

A BIRD-LOVER'S OUTDOOR AVIARY

EDITORS' NOTE TO MOTHER AND TEACHER.—Your mother and grandmother can remember the time when it wasn't thought to be so very wicked to rob birds' nests, or even to kill song birds for their pretty wings. Isn't that strange? But, in nearly every village in the land there was some wise, kind man or woman who knew these things to be not only very wicked but very foolish. If it had not been for these few, scattered bird-lovers, who protected the little feathered friends that sing to us so sweetly, and work for us so willingly, we would not have as many wild birds as we have today.

This is the story of one of these old-time bird-lovers and his bird-haunted garden. He was a country doctor. He lived in a village in the middle West, in a small white house with green shutters. In his large garden he had many beautiful trees, and the finest flowers and fruits and vegetables in the town, although he never seemed to take any more pains with them than his neighbors. People said he was lucky, or had the "knack" of growing things. But the wise doctor only smiled and said:

"I have all my little feathered friends to help me." Few people understood just what he meant by that.

As the years went by, and wild birds became fewer, the doctor's garden was almost the only place in the town where many of them nested. Then people went to the doctor's house, to see and to hear the birds they had driven from their own door yards. The dearest treat the doctor kept for his little human friends, was to invite a few of them at a time to a sunrise concert on his vine-covered side porch. There, as still as little mice, they could listen to the bird songs, look through the doctor's big field-glass, and watch the happy singers at work or play. Now and then, the quietest child of all was allowed to peep into a big knot-hole in a fence post, and look at Mama Bluebird sitting on her eggs.

That is the way in which one little girl learned to know and to love our wild song birds. Don't you want to go into the doctor's garden, and watch the birds as they come north in the spring? You can learn to know them by their songs and colors, their nests and babies. You can learn how they helped their good friend grow flowers and fruits and vegetables. And you can learn how he made them understand that they were wanted, and would be protected. If you know all these things you, too, can have the wild song birds for summer visitors wherever you live. They will come to farms and into sheltered gardens of houses in large towns, and into the parks of the very largest cities.

PART IV—BIRDS

I. BIRD SONGS AND COLORS

The doctor was never quite sure which of his little friends in feathers arrived first in the spring—the bluebird, the song sparrow or the phoebe. Some morning in March, often before the snow was off the ground, he was awakened by a “pewit-pewee!” below his dormer window. There was seven-inch-long, cream-breasted, black-billed phoebe, fluttering about the leafless vines of the porch, singing her friendly greeting of just four notes. But from under the lilac and syringa shrubs he was sure to hear, about the same time, a “tweet, tweet, twittering,” for all the world as if some one’s pet canary had escaped from its cage. That was Mr. Song Sparrow, gray-brown of back and wings, speckle-breasted, busy and cheerful, stopping every now and then to twitter and trill from some low perch. But the doctor was apt to see the bluebird first, because of its bright color.

Did you ever see a sapphire (saf-fire) in a ring? It is a lovely, deep, sparkling blue stone, like a blue diamond. The blue bird is the sapphire of the air. His wings and tail are tipped with black. His breast is as red as the robin’s. He really is a cousin of the robin’s. Both belong to the big, musical family of thrushes.

Pretty Mr. Bluebird comes all alone. His sweet solo is something like this: “Here I am; all alone: Oh-oh-I-oh, pur-i-ty, cher-ish me!” It is the loveliest melody, a little bit sad, until his mate joins him a week or so later. Mrs. Bluebird has the same colors, but they are not so bright. That is the rule in the bird world. Papa wears the gayest coat and sings the finest song. But every bird thinks he has the dearest, prettiest little mate in the world. He greets her with a song of joy. In the doctor’s garden, Mr. and Mrs. Bluebird always sat close together on a low limb of an apple tree, when they arrived in the spring, and talked things over, oh so tenderly! Then they flitted about the place looking at housekeeping rooms. By and by you must see their little house and babies. They never thought of being afraid, for the doctor’s plummy-tailed collie dog—

Rob Roy—always lay on the porch to keep an eye out for stray cats, hawks and squirrels.

When Mr. Robin comes, a little later than the bluebirds, he wears a smart new spring suit of brown, with a gay red vest. He welcomes his little mate with a happy, mellow song. "Chirp, chirp," she answers faintly from the grass. "I'm rather tired from the journey, dear." "Oh, cheer-up, cheer-up!" he answers. Down he drops to her side, and perks his knowing little head to this side and that, as if to say: "I think I hear a worm!" Suddenly he stabs the ground with his bill, braces his stout legs, gives a jerk and up comes a fat grub for Mrs. Robin's wedding breakfast. Up to a low branch he flies and sings her another song of pride and joy.



ROBIN

All the male birds have a love song for their mates. Both birds have call notes, and harsh alarm notes to warn of danger, and to frighten away enemies. And they have talking tones. Mates will often flit about near each other, and exchange remarks. Very likely they are just talking about the weather, or the food supply, or their neighbors. You can spend a whole summer watching and listening to one family of birds, and learn something new and interesting every day.

If ever you do that take a thrush for first choice. The robin, the bluebird, the brown thrasher and the mocking bird are thrushes. Nearly all the thrushes have beautiful manners and sweet singing voices. The mocking bird is one of the greatest singers of the feathered world. He is all our own, too, for he is not found in any country of the old world. He nests in our warm southern states. But once in a great while he comes north. So, it was the pride of the doctor's heart to have a pair of mockers nesting in a spruce tree in his garden, for two or three summers.

When the mocking bird begins to sing he springs or bounds upward, as if too happy to stay on the earth. The mocking bird is as long as the robin, but more slender. In color he is rather sober—gray above, with dark brown wings and tail that are tipped and lined with white. When the moon is full he often sings all night long. The only other bird that does this is the old-world nightingale. Our

great poet, Longfellow, describes the mocking bird's song in Evangeline:

"Then, from a neighboring thicket, the mocking bird, wildest of singers,
Shook from his little throat such a flood of delirious music,
That the whole air, and the woods, and the waters, seemed silent to listen."



MOCKINGBIRD

Beside his own song he mocks all the other birds. He warbles and chirps and whistles; he twitters and trills, so you might think all the birds were holding concert when he sings.

The mocker's nearest rival in the garden was a red-brown-backed cousin, with a brown-spotted vest of cream color. Sometimes he is called the brown thrasher, from the way he thrashes his tail about. And he is called the brown mocker, too. One thing he does is to mock himself. He perches on a lofty branch of a tree to sing. Long black bill open and pointing skyward, he sings a song "like a babble of water in a brook."

When the song is finished he seems to say: "I wonder if I could do that again." And he does it, exactly as he did it before. The English poet Browning has noticed it:

"That's the wise thrush, who sings each song twice over,
As if you might think he never could re-capture
The first, wild, careless rapture."

Besides his own song, "twice over," the brown thrush sings choice bits from a dozen other bird songs, one after the other. "Hear me! Hear me!" he trills: "I can sing this, and this and this. Oh, the joy of it,—under the blue—in the sweet wind—swinging. Don't you wish—you could do it? Try, try, try, yes you can, truly, truly!" Such a little cataract of melody, to fall from the high branch of an elm.

The cat bird is a mocker, too. He is a thrush who can sing a pretty song when he wants to. But he is a saucy fellow. He caws like a crow and meows like a cat, to scare his timid neighbors into spasms, and to waken Rob Roy from his nap. Then he laughs at the joke. Do you know Mr. Cat Bird? He is quite a dandy, in a coat of London smoke and a pearl vest. He has a rusty red tail

that he jerks about when he sings. He skulks under bushes, and pounces on his creeping prey like a little feathered wild-cat.

If the bluebird is the sapphire of the air, there is no jewel at all to compare with the glowing orange of the Baltimore oriole. He is a cousin of the blackbirds, as you might know from his velvet black wings and tail, and his flute-like whistle. His olive-backed, lemon-breasted mate sings, too, a lovely alto to his clear soprano. They sing the dearest duet you ever could hear. The orchard oriole has a black coat and hat, too, but his vest is a reddish brown, and his wings and tail are barred with white. He and his dull, olive and yellow mate sing duets, too, in richer, less whistling voices than the Baltimore. If you are not sure of the orchard orioles look for their pretty, sky-blue shoes and stockings.

No blackbird is shy, you may be sure. The orioles always fly about in plain sight, and talk freely of themselves and their affairs. A hot-headed, blustering little fellow is the oriole, noisy, restless, talkative; always whistling gaily like a happy school boy, in sun, wind and rain. He has scolding notes for meddlesome neighbors, too. The orchard oriole is a good policeman. When he sounds his harsh, alarm note: "Chack!" every bird in the neighborhood knows it is time to skurry to cover.

If the doctor hadn't had a cow, and a pasture lot for her with a pond in it, and low elder and hazel and briar bushes around it, he wouldn't have had some of the blackbirds nesting near him. A hedge of thorny, ruddy-flowered japonica was between the garden and the pasture. Often a gay flash of black and white, with a yellow patch on the back of the neck, tumbled up out of the meadow onto that hedge. It was the bobolink. He sang and swung and flirted his wings and tail. He chattered and gossiped and whistled. He just bubbled over with high spirits and innocent fun. Up and down the scale he sang, like a musical acrobat on a trapeze. But most of the time he just bubbled out his own saucy name.

"Bob-o-link! Bob-o-link! Spink, spank, spink!" Dear little rascal. He had no trouble at all in winning a wife!

In the cat-tails and rushes about the pond was always a colony of red-winged blackbirds. Glossy fellows the males were, in jetty coats with red, gold-bordered shoulder knots. They strutted and danced and jumped and whistled "Bob-o-lee!" or, as some bird lovers understand: "Con-quer-ee!" It can hardly be called singing, this explosive gurgle.

But oh, the meadow larks that nested in that pasture! This little brown-backed, and spotted-yellow-breasted singer, with the necklace of jet and white-tipped tail, is the Jenny Lind of our grass-lands. You cannot walk along the edge of a clover field but he may spring up at your feet, perch on a fence or bush, and pour out a melody like flutes and violins, and human voices in vesper hymns. Yet, so few notice the meadow lark that Audubon, our greatest bird student, called him *neglecta*.



MEADOWLARK

He is not a lark at all, as is the English sky-lark. He is a cousin of the blackbirds, the orioles and bobolinks. He walks like the blackbirds. He comes to us in April and sings all summer long, on the ground, on perches and on the wing. He is one of the very greatest of bird singers, rivalled only by the nightingale, the mocking bird, and the brown and hermit thrushes.

There was rivalry among the children as to who should first spy the tanager in the doctor's garden. A flash of scarlet flame across an open space, and the tanager is gone! This glowing coal of a bird with black velvet wings and tail, really belongs to a tropical family. He seems as strange among our wild birds as an orchid in a meadow. He flits about in silent places, singing a lovely little chant, as sad as the dove's but of varied melody. To his mate he sings a low sweet warble. He calls like a robin, and he "throws" his voice like a ven-tril-o-quist, so you will often think him somewhere else.

The cinnamon-brown, spotted-breasted hermit-thrush of our northern pine woods can "throw" his voice, too. He is as shy as the tanager. Perhaps both of them do that to deceive hawks and squirrels and other enemies as to their whereabouts. The tanager's mate is a dull olive and yellow. Very soon he, too, takes off his scarlet and black



WOOD-THRUSH

cloak, that attract far too much attention, and wears her shabby working dress. So, if you see the tanager in his dress of flame and soot at all, it must be in the spring or early summer.

"Tweet, tweet, twitter, twitter, tweet!" Haven't you heard that often from roadside weeds, where dandelions and thistles have gone to seed? No, it isn't the speckled song-sparrow of the low bushes. It is a little black and yellow cousin of his—the gold-finch, or wild canary. Canary yellow with black wings and tail, he flies as a little canoe rides the water. Such a playful, sweet-tempered, "tweet, twittering" little fellow he is. He seems to waste half the summer idling, but he is really waiting for those downy weed seeds to line his pretty nest and to feed his babies.



GOLDFINCH

The finest singers of America are thrushes, black-birds and finches. The finches all have the canary twittering songs; the blackbirds the whistling, bubbling notes. The songs of the thrushes are pure rich melody, and many of them mock the songs of the warblers, the finches and the blackbirds. Another twittering finch is the snow-white and dead-black, short-billed grosbeak, with the patches of lovely rose color on the breast and under the wings. The cardinal grosbeak, or Virginia nightingale, is a finch, too. His voice is so fine that this ruby-coated and crested singer is often caged, as is his cousin the canary.

The eaves of the doctor's barn was a great place for swallows. A big colony of them skimmed and wheeled about, the sun glistening on their blue-black forked wings and tails. They chattered, scolded intruders, and sang sweet gossipy songs to each other. The wrens came right up to the house and sang from the roof, the low bushes and the ground. Bill up, perky tail jerking about, this merry singer is a nervous little scold at times. "Five inches of brown fury in feathers," the doctor called Mrs. Jennie Wren. She scolded the house

cat, she scolded big policeman-dog, Rob Roy, who was really guarding her family. She scolded every human body about the place. She even scolded that bird-bully, Mr. Blue Jay. He didn't get to come near *her* eggs! Plucky little Mama Wren! She is the gritty little terrier of the bird world.



BLUE JAY

Only the blue jay can rival the wren as a scold. A handsome fellow he is, in six shades of blue, black, white and dove color. He has a crested head, stout bill, excited wings, a terrible squalling voice and stamping feet. He is always ready for a scrap. He is a good deal of a blusterer, and one pair of blue jays is quite enough for the peace of a small garden. He'll tell you who he is as soon as he comes, by squalling his name: "Jay, Jay, Jay!"

The king-bird is as trim as you please in a coat of iron gray, a pearl bib and an orange-red patch on his head. He cries: "Ky-rie, Ky-ky, ki-yi," much like a very small yelping dog. He is a cousin of the phoebe and wood-pewee, belonging to the fly-catcher family. Old red-head, the dark-blue, black and white wood pecker, with the red hood, just chuckles and drums. His cousin, the flicker, or golden-wing or yellow-hammer, laughs and chatters and drums, and plays tag around tree trunks. You can always know the wood-peckers by their drumming, the big black crows by their cawing, the scary-eyed owls by their who-who-ing, the doves by their mourning, the cuckoos and the jays by their calling their own names.

You will have to have very sharp eyes and ears to see the butterfly hovering of the humming bird—ruby-throat—and to hear its tiny mouse-like squeak. And among the noisy orchard orioles in the apple trees, the quaker-brown-and-fawn colored cedar birds are apt to pass unnoticed. You may know them by the brown crest on the head, the black spectacles around the eyes, and the row of red, wax-like spots across the wing tips. They are also called cherry-birds and wax-wings. They have no song, only a call note, and soft, polite, talking tones. Their manners are as beautiful as those of the blue-birds. They dress each other's coats with the sweetest little bows and lisping apologies,



KINGBIRD

as much as to say: "Pardon me, but there's a feather out of place."

There are ever so many more birds in our gardens, woods and fields. Mr. John Burroughs says forty or fifty song birds visit us every summer. Most of them belong to the families of the thrushes, the finches, the blackbirds, the wrens, swallows, woodpeckers, flycatchers and little warblers. It is the small birds that sing. And you can tell what family a bird belongs to by its song and its food habits, more than by its colors or its nest. How many of our wild birds do you know? Their names and a good many of their pictures are in this book. (See BIRDS, THRUSH, BLUEBIRD, MOCKING BIRD, ROBIN, CATBIRD, COWBIRD, BLACKBIRD, MEADOWLARK, ORIOLE, BALTIMORE ORIOLE, BOBOLINK, TANAGER, FINCH, GOLDFINCH, SONG-SPARROW, GROSBEAK, CARDINALBIRD, SWALLOW, SWIFT, MARTIN, WREN, JAYBIRD, KINGBIRD, PHOEBE, PEWEE, TITMOUSE (chickadee), TOWHEE, CEDARBIRD, HUMMINGBIRD, WOODPECKER, FLICKER, SAP-SUCKER, OWL, DOVE, WARBLER.)

II. BIRD NESTS AND BABIES

One spring the doctor got all ready to put a new roof on the kitchen wing of the house. Mrs. Doctor said it leaked *ter-ri-bly* every time it rained. The carpenter came one Monday, early in April. But on the Saturday before, Mr. and Mrs. Jennie Wren had moved in under a broken shingle. They flew at that man. They told him just what they thought of him for trying to break up their housekeeping. The doctor laughed and told the man to go away, and not to come back until the wren babies were out of the nest.

A hat full of trash was taken out of that hole! There were twigs, grass, leaves, strings, rags and shavings, all laid loosely in a cup, and lined with feathers from the chicken yard. The wrens are fond of building, and any sort of a hole suits them. They will use an old shoe or a tin can. This pair built a second nest in the pocket of an old coat the doctor had hung up in a shed. If you nail some tin cans or cigar boxes up any where near the house, for nests, you can always have wrens living near you. In a wren's nest are laid as many as six flesh-colored eggs, spotted with tawny pink.

Of all the birds in the garden, the orioles made the finest nests, putting into them days of skilled labor. Orioles are weavers. The Baltimore oriole weaves a hanging purse of a nest, on the highest limb and the farthest twig of an elm tree. Sober little olive-and-yellow Mama Oriole is the artist. Gay orange-and-black Papa Oriole is merely the hod carrier. He gathers long blades of dry grass, strands of bark from grape vines and milk-weed, strings, wool, hair, thread and feathers. He has to find all these things, one at a time, and carry them up to the limb, that may be fifty feet in the air. Then he sits near his little mate and sings to her. He tells her how much he loves her, and how clever she is. He brags that no squirrel can run out to that nest, or cowbird lay an egg in it, or hawk get to the bottom of it. She works quietly and steadily, and sings her pretty alto with him, sweetly.

First she takes the longest, strongest bits and ties both ends to the twig. She ties hard knots, using her bill to pull the ends through tight. She does this until she has a number of loops, as deep as she wants the nest, for the warp, or up-and-down threads. Then she begins to weave in and out, taking a thread in her bill



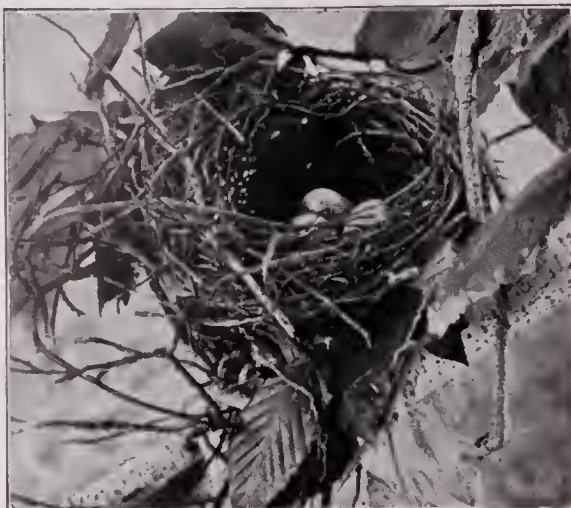
HUMMING BIRD'S NEST.



PHOEBE'S NEST BUILT ON A BEAM.



WORM-EATING WARBLER'S NEST.



BLUE JAY'S NEST.



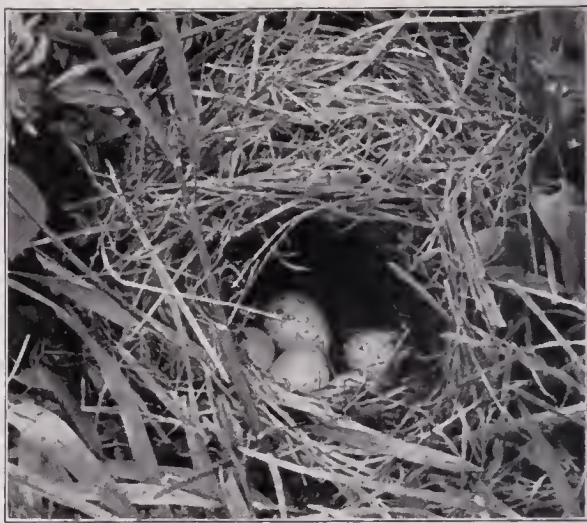
CROW'S NEST WITH YOUNG NEARLY READY TO FLY.



WOOD THRUSH ON NEST



VESPER SPARROW'S NEST.



NEST OF YELLOW-WINGED SPARROW.



REED-WARBLER'S NEST BETWEEN THREE REED STEMS.



WOOD PEWEE'S NEST.



WARBLING VIREO'S NEST



WHITE-EYED VIREO ON NEST.

and poking it and pulling it back and forth. She weaves a lining of hairs and feathers. Finally she *over-casts* the top, to make it strong. When it is done she lays from five to six white eggs, blotched with splashes of brown. Then she drops to the bottom of the pocket cradle that swings in every breeze, and sits there for fourteen days.

Oh how her mate sings to her! He flashes about the tree, chasing away other birds. He relieves her when she wants a lunch. He brags and trills; he tumbles about and very nearly goes crazy with joy and pride. But one morning he is suddenly as silent as the tanager. His coat begins to fade. There are babies to be fed! Both parents must work hard, and keep quiet, to feed and protect those infants.

If you find a basket-shaped nest as skilfully woven as this, but lower down in an apple tree, it belongs to the orchard oriole. The oriole's cousin, the meadow lark, makes a more loosely woven nest on the ground, in the high grass along the edge of a meadow. Above it she ties the tall stems of grass and clover together. This makes a dome to hide the nest and to shed rain. And she makes a cunning arched passage to the nest, with the opening some distance away. The whole looks, from above, to be just a tangle of tall growth. The meadow lark is very clever, as are all the blackbirds.

The red-winged blackbird makes a loose but stout nest, braced up in a cluster of cat-tails or flags, or in tough wire-grass near the ground. The eggs are bluish-white with violet and brown streaks and black spots. The bobolink, rollicking fellow, is very careful to hide his shallow, shaggy nest of leaves and grass in high growths on the ground. The bobolink's eggs are stone gray, marked like the eggs of the red-wing.

You cannot tell the kind of bird by the nest or its situation, any more than you can by the color of the bird. Here is one blackbird weaving a beautiful pocket high in the air, and other blackbirds nesting in loose bowls on and near the ground. Among the thrushes the robin is the best nest-builder. The bluebird uses a hole like the wren, but in an orchard tree or a fence post. The robins make a stout nest of twigs, plastered with mud and lined with soft grass, moss and feathers. They use oaks, maples and fruit trees on lawns and in orchards, and will even build in stout vines under the eaves of porches.

You should never tear down an old robin's nest. This is why. A pair of robins will come back to the same nest year after year. They will clean the old nest and repair it with new twigs. Mama

Robin will put on a new coat of mud, using her pretty breast for a trowel. Then she will go to some pool, take a bath, make herself tidy after her dirty work, and lay four or five eggs of robin's egg blue.

Bluebirds will use the same hole in an apple or maple tree, or a fence post, year after year, if they find it vacant. Or they will use a woodpecker's hole, or a clever bark cylinder of a nest if you put one up. Bluebirds are not builders. They put a scanty lining of weeds, grass or feathers in the best hole they can find, and Mama Bluebird lays from four to six eggs a little paler than the robin's. The mocking bird that came into the doctor's garden built a loose, round nest of crooked twigs lined with grass, rags, strings and moss, in a branch of a pine tree, only ten feet from the ground. Its eggs were a pale green, delicately spotted.

Most of the other thrushes—the brown and hermit thrush and the cat-bird, nest on or near the ground. The nests are clumsily made of roots, bark, sticks and leaves, rags and paper. The eggs of the brown thrush or thrasher, are cream colored, speckled with brown, like the papa's own pretty breast. The cat-bird's eggs are a beautiful blue-green. You may easily mistake the nests of the brown thrush and the song-sparrow. Both build on the ground, under low bushes, and of rough materials. But the song-sparrow's nest is more thickly lined with soft hair and feathers.

You wouldn't expect as wild and silent a bird as the scarlet tanager, to build a nest ten feet from the ground, at the end of the limb of a wild crab-apple tree, would you? It is made of twigs, roots and shredded bark, loosely woven and lined with soft fibres. The eggs are a dull white or greenish blue, spotted with brown and violet, something like a blackbird's but more thickly spotted on the blunt ends.

The king-bird, too, builds a big, clumsy nest in an orchard tree or maple, right out in plain sight. But he is ready to defend it with much bustle and talk, telling everyone that this is his castle and no visitors are welcome. The jaybird builds a loose nest, too, but in a high branch. And he doesn't disdain to use the deserted nest of a crow. That shows his good sense, for the crow flies high and makes a stout nest of sticks and all sorts of things. He stuffs all the cracks with moss, and he plasters it outside with mud so it is often good for a couple of seasons. Besides, he lines it thickly with horse hair, moss and wool, for little crow babies are perfectly naked.

The swallows are even better masons than the robins and crows. They make their entire nests of little pills of mud, mixed with straw and their own saliva. Like the robins, too, they repair their old nests. A barn-swallow colony comes back to the old home and looks over the wind and frost battered rows of mud and straw nests under the eaves and along the rafters. They stuff up holes, and put in new linings of straw and chicken feathers. They are so trustful of their human friends that they never conceal their whereabouts, or their babies. They throw bird-egg shells, nest refuse and everything overboard, right under their nests. Most birds are very careful to carry their sweepings to a distance.

Little phoebe with her "pewit-pewee" is confiding, too, like the wrens. She builds her nest of moss and mud around dwelling houses, and under low bridge arches. The cedar-bird likes a cherry or a cedar tree. She makes a large nest as neat as her little quaker self, of clover stems, pine needles, grass and shredded bark. She is a late builder although she comes early. It is June or July before she lays her four or five clay-colored eggs. The gold-finch doesn't build until there are the softest thistle and dandelion seeds to line her pretty nest of fine grasses. She builds it in the crotch of a tree, not over twenty feet high, and in it lays from four to six pretty bluish-white eggs.

If the orioles are weavers and the swallows masons, the woodpeckers are carpenters. A pair, working together, chisel out a home in hard, clean wood. Old red-head's nest is often a foot deep. The door to it is a round auger hole that goes into the tree, then curves downward and swells out. The hole is the shape of a crook-necked gourd. Papa Red-head chisels for twenty minutes, then the Mama relieves him. Both of them work, in relays, from dawn until night-fall. Flat-chested, hump-shouldered, stout toilers, the woodpeckers have to dig their clean nests, and then dig for grubs to feed themselves and babies. They are the hard laborers of the bird-world.

What a hurried, worried time it is for the parent birds when the baby birds are out of their shells. The nests must be cleaned of the egg-shells and dirt, and every baby kept perfectly clean. Crow babies are naked and very tender skinned. Bird babies look to be all mouths. They lie helplessly in the nests, bills wide open, crying every few minutes for food, and what a lot of it they can eat!

Every few minutes one or the other of the robin parents hurries to the nest with a mouthful of worms. The babies just lie there,

big yellow bills open, and eat two or three times their own weight of worms every day. From dawn until dark a worm must be found every two minutes to keep a nest full of young robins fed. That means several hundred in a day for one brood!

The bluebirds forage the lawns and orchards for grubs and insects; the blackbird the corn-field for cut worms; the orioles for small caterpillars; the woodpeckers for wood borers; the swallows for winged fliers. Nothing that bores, or creeps, or flies, or burrows in the ground, but goes to feed the nestling. Wild and tame fruits and weed seeds are hunted, too.

When they come out of the nests every kind of bird baby acts differently. The orioles are cry-babies, crying to be fed even when they are able to fly. The wren babies make for the nearest holes—a water spout or rat hole, perhaps—and have to be coaxed and scolded to safe perches in bushes. Little speckle-breasted robin babies hop after their parents and soon learn to be quiet. The woodpecker babies are stupid and clumsy, and expect to be fed a long time. The jays are scarcely out of the nest before they begin to scold. The king-birds are the most sensible of all. They mind their parents, stick close together, and learn how to look out for themselves.

When the bird babies are out you can see several of the prettiest things in bird family life. You can see Papa Robin and Papa Bluebird and Papa Wren taking care of the little ones, feeding them, teaching them, protecting them. The mama birds are busy hatching other broods. You can see swallows meeting, and seeming to kiss in the air. The older birds are feeding the young ones, on the wing. And you can see many a lesson given in singing, in food-finding, and in skurrying out of sight when alarm notes are sounded. You can watch the little ones taught to bathe in tiny pools, or to flutter in the dust bath.

Such anxious, hard-working times as birds have when bringing up their families. No wonder that, in mid-summer, the songs of many are silenced; the gay coats dropped, or grown shabby. But the robin is cheery to the last, the meadow-lark trills as joyously as in the spring, the gold-finch twitters among the late thistle down, and the brown thrush trains her family in the art of singing. But most of the birds, weary and sad-colored, leave us in silence, and fly away for the winter, to grow fat, gaily feathered and tuneful, in the warm south. (See names of birds, also BIRD'S NESTS and NESTING-BOXES, with plate.)

III. LITTLE FRIENDS IN FEATHERS

One sunny Saturday afternoon in June, a tanned, dusty-legged boy came to the doctor's side porch. In one hand he had a soft, limp bundle of snow-white, dead-black and rose-colored feathers. In the other he carried a sling-shot! A shame-faced lad he was, for not a boy in the town would purposely kill one of the doctor's birds. He had just aimed at the tempting singer on the picket fence of the vegetable garden.

"But doctor," he said, "perhaps you don't know that this bird was eating your green peas. I saw him."

"Let us see," said the doctor. He opened the little crop, under the rosy spot on the breast that would throb with song no more. Yes, there were as many as two pods full of young peas. But the little vestibule to the stomach was packed full of potato bugs—the striped Colorado beetles that were eating all the potato patches in the town.

Out on the picket fence the mother grosbeak had all her babies in a row, and was feeding them the beetles. Black-headed grosbeaks were there, too. In a few days the doctor's potato plants were picked clean, and the birds were foraging in nearby gardens. "One pair of grosbeaks brings up a brood of four or five in a season," said the doctor. "One pair of Colorado beetles breeds to 50,000,000. For the good potatoes these pretty singers help me grow, I can spare them a whole row of peas."

That was a lesson one little girl never forgot. The doctor always opened the crops and stomachs of dead birds. In a robin's stomach in June he found a few orchard cherries, among the insects and wild fruits.

"The robin comes to us in March," he explained to a sober little group. "For three months he has nothing but worms, ground beetles and dry, winter berries to eat. He brings up one brood of babies on such food. No wonder he wants a few juicy cherries in June. But he likes the Russian mulberry just as well, and we don't care for that fruit." The doctor made a note to plant a mulberry tree for the robins, cedar-birds and other orchard lovers. Nine-tenths of the robin's food is insects and wild fruits. Only in June and July does he eat cherries to pay for the six months' work he

does for us so cheerfully. He eats beetles, grubs, worms, caterpillars, spiders, snails, grasshoppers, wild grapes, blue-berries, service berries, choke berries, black alder and holly-berries, rose hips and the seeds of sumac.



SWALLOW

There were always dead birds for the doctor to study. Woeful little tragedies happened in the nests. Once, a pretty mother oriole was hanged by a loop of horse hair, in a nest she was weaving. For hours the mate made wild lament for his loss. Then, a high wind tumbled the half-finished nest and the dead weaver to the ground. Nothing but insects were in the little stomach—beetles, ants, wasps, spiders, bark scales, plant lice and caterpillars. In mid-summer the oriole eats a few grapes and peas. Can't we spare her those for the countless insects she eats and feeds to her babies?

A barn-swallow, hurt in some way on its northward flight, had fed on cotton-boll weevil, in flying over the young cotton plants in the south. And she had eaten flies, mosquitoes, gnats and little wasps, and in her stomach were the broken wings of the gad-fly that stings horses. The doctor put more brackets under the eaves of the barn, on which these little friends of barnyard animals could brace their nests.

For the house-wrens and bluebirds the doctor put up box nests. For the phoebes he had a grape-arbor and a vine-draped porch. For the chickadees he planted a thick hedge; for the brown thrush and song-sparrow low-growing shrubs. There was a mulberry tree for the orchard birds to feed upon, a cedar tree for wax-wing. And along the pasture he let the elderberry bushes, wild blackberry briars and briar roses grow, for the fruit. There were sumac bushes, too, and alder saplings, a choke cherry and other wild fruit and seed-making trees. For years and years he kept on telling his neighbors that nearly all of our wild birds are insect, wild fruit and weed seed eaters.



CHICKADEE

Each kind of bird has its special work to do. Woodpeckers go under the bark of forest trees for wood-boring beetles and grubs. The cuckoo, or rain-crow, eats hairy caterpillars. The only other birds that can manage these are the orioles. In the stomach of one cuckoo the doctor found two hundred web-worms. The robins clear our lawns; the bluebirds, cat-birds and cedar-birds forage in the orchards. The wood thrushes and flickers feed on the ground in groves. The meadow-larks, bobolinks and red-wings hunt in the pastures and swamps. The swallows, the king-birds, the phoebes and other fly-catchers are raiders of the air. Wrens forage in low plants, shrubs, and in cracks and crannies of house walls and fences. Hawks and owls hunt mice and moles. In August, all the insect-eating birds make a feast of grasshoppers. One brood of robins eats half a million insects and larva in a summer, and not a thousand cherries.

For many, many years scattered bird lovers told their neighbors these things. Some of them were laughed at, some only half believed. The wild birds became fewer and fewer. The nests were robbed, the singers killed for their pretty wings. The farmers drove the birds away. Then we began to have wormy orchard fruits, army worms, canker and cut-worms, tent caterpillars, boring weevils, flies, plagues of grasshoppers and Colorado beetles. Countless unseen enemies ate up the farm crops, orchards and gardens, and even the grass on the lawns. We looked everywhere for help except up in the air.

Then it was that our government began to study our bird friends. In the farmer's bureau in the capital at Washington, thousands of little stomachs were opened, in every month of the year. Every bit of food found in them was written down. We know, now, just what every wild bird eats, in every season. If a bird has a bad habit we can help him cure it. The crow pulls up young corn plants for the softened seeds. But if the seeds are soaked in tar water before planting he will not touch it. But he will go into the corn fields for cut worms.

We have taken the trouble, here, to find out for you, from many bird books, and from farmer's bulletins printed by our government, just what our commonest wild birds eat, and how they help us. First of all remember that:

Woodpeckers, cuckoos, swallows (swifts and martins), phoebes, pewees, king-birds and other fly-catchers, wrens, hawks, night-hawks (bull bats) and owls, live almost wholly on animal food. The chick-

adees are insect feeders, too. They stay with us all winter, and hunt out sleeping flies, and the eggs and chrysalids of moths and beetles. The king-bird is called the bee-martin, and has been accused of eating honey bees. It has been found that it eats only drone bees. Drones have white faces, and no stingers. And it catches the robber-fly that destroys bees. King-birds protect poultry yards and other song birds by driving away hawks, crows and jaybirds. They eat such wild fruits as elder berries. Hawks and owls live mostly on mice, moles and other small rodents. Woodpeckers eat the fruits of the dogwood, Virginia creeper, poison ivy, sumac and the nuts of beech trees. No farm, garden, orchard, park or lawn can afford to be without the insect feeders. A woodpecker or king-bird should never be disturbed. Wrens, swallows, phoebes and chickadees should be encouraged to nest near our homes.

Among the useful seed eaters are doves, pigeons, the native sparrows, and the gold-finches or wild canaries. Mourning doves eat the seeds of weeds and the gleanings of grain fields. One-third of the food of our native sparrows in summer is insects, but the hard seeds of grasses, weeds and waste grain is the chief food. The goldfinch eats weed and thistle seeds, and bush buds. A very useful bird on a farm is the quail (bob-white or partridge). Two-thirds of its food is weed seeds, the rest harmful insects and waste grain. The English sparrow is a pest. He lives in flocks, is quarrelsome, drives away our song birds, and lives on us all the year around, eating only the useful grains. He is the feathered mouse, and should be treated as a pest.

All the rest of our wild birds use a mixed diet of insects, seeds and fruits. The amounts differ with each, and with the same birds in different seasons. Thus, from March to June, the robin lives on ground beetles, larva, angle worms, spiders, snails and dry berries left over winter on bushes. He helps himself to orchard cherries in June. Late cherries he does not touch, for then the choke cherries, elder berries, cranberries, briar berries and sumac seeds are ripe. The Russian mulberry, that ripens with the early cherries, he really prefers. Plant a mulberry tree, and fruit-bearing shrubs and vines on the edge of an orchard, and the robin, bluebird, cat-bird, cedar-bird, jays and many other birds will do little harm to the cultivated fruits. In August, the robins eat grasshoppers and wild fruits.

Three-fourths of the bluebird's food is insects, the rest wild fruits and seeds. The meadow-lark's food is three-fourths ground

insects, the rest waste grain and weed seeds. Orioles live almost entirely on insects, hairy caterpillars forming one-third of the food. They eat a little fruit in mid-summer. No peas or grapes were found in many stomachs examined. All the grosbeaks are enemies of the Colorado beetle. One family of grosbeaks can keep a good-sized patch of potatoes free of this pest. They also eat the pupa of the coddling moth that lays the apple worm.

The grosbeaks eat some green peas, small fruits and waste grain. They pay ten thousand times over for every useful thing they eat. Cedar (cherry or wax-wing) birds, like the robins, eat some early cherries. But they prefer mulberries or cedar berries. In late summer and fall they live mostly on weed seeds and wild fruits. The nestlings, at first, are fed on insects. These birds eat the elm-leaf beetle and plant lice as well as grasshoppers. The cat-bird eats about half animal and half vegetable food. Insects and wild fruits and seeds form the bulk of its food. A government report says of it: "The cat-bird has a bad name, but it does more good than harm." The mocking bird, brown thrasher and nearly all the thrushes have much the same food habits as the robin and bluebird. Two-thirds of their food is insects, the rest wild and tame fruits.

The government pays special attention to jays, blackbirds and crows, for most people think these birds have no good qualities at all. Jays eat everything; seeds, acorns, nuts, fruits, insects, the eggs and young of other birds, and even of the poultry yard. They eat mice, fish, snails, and they rob orchards. The conclusion is that "the character of the jay bird is not all that could be desired."

With the blackbirds it is a different story. Orioles and meadow-larks are among our most useful bird friends. The red-wings' food is eighty-five per cent insects and weed seeds, eaten in marshes where many weeds and crop enemies breed. Less than ten per cent of its food is grain. The crow blackbird eats forty per cent of grain. The bobolink feeds on insects and weed seeds when nesting in the north, but rice when migrating. It is the English sparrow of southern rice fields. There it is called the rice or reed-bird.

The crow does pull up corn, rob song bird's nests, and kill small chickens in the poultry yards. Corn seeds can be protected from Mr. Crow by soaking in tar water, and a few kingbirds nesting nearby, can protect little chickens and birds from both crows and hawks. To the credit of the crow are the field and barn mice, moles, May beetles, June bugs, cutworms and grasshoppers he eats and feeds

to his family. The crow eats no orchard fruit, and only a little corn in the milk. He is not afraid of scare crows, but he is shy of bits of bright tin or looking glass strung across the tops of corn fields, and flashing in the sun. A few precautions will make the crow a good and useful neighbor.

Birds are our little brothers of the air who help us keep the earth green and fruitful. They alone are able to keep the unseen armies of insect enemies in check. We need their help, and how willingly they work for us. Of all our little animal brothers they alone can sing and fly. They take up no useful room, and they earn their own living. At the same time they make the world a more beautiful place to live in.

They have so many human ways. They love their mates; they care so tenderly for their babies. They have such skill, such industry, such courage, such devotion to duty, such grace of movement and beauty of plumage and voice. Don't you think, since they help us so much, we should be willing to help them a little? All they want is protection, and a little help in the kind of food they need, where wild fruits and seeds do not grow. Provide nesting places for them about town houses. Where they are wanted they will come, year after year. Then, when they fly away in the autumn, we will know that they have helped us grow grains and fruits, vegetables, shade trees and flowers. See names of birds, beside OWLS, HAWKS, PIGEON, CUCKOO, QUAIL (plate), HOUSE PETS (cats to be watched).

WILD ANIMALS YOU WOULD LIKE TO KNOW

EDITORS' NOTE TO MOTHER AND TEACHER.—Wild animals have a wonderful fascination for children. About the traits, habits and homes of those most commonly to be seen in menageries and city park zoos, they never tire of hearing. Ample accounts of these animals, giving the classifications and main facts by which they may be identified, are to be found under the appropriate headings in the body of this work. Those accounts should always be read first. The pictures should be studied, and drawings and clay models of the animals made. In no other way than by the graphic arts, can the facts of life be so firmly and accurately impressed on a child's mind. The child is then ready for peeps into the wonderland of the intimate life of wild creatures. Unconsciously, and with the keenest interest, he absorbs a great deal of geography, zoology and related subjects, and sees the animals in their relation to human beings, their place in literature and folklore, and their claim on his sympathy.

I. BIG BROTHER BEAR

W'y, wunst they wuz a Little Boy went out
In the woods, to shoot a Bear—an' he
Wuz goin' along—an' goin' along, you know,
An' purty soon he heerd somefin go "Wooh!"—
'ist that-a-way—"Woo-ooh!"

—James Whitcomb Riley.

You ought to get Mr. Riley's poems and read the bear story that little Alex, who couldn't talk plain, but who knew all about bears, " 'ist maked up his-own-se'f."

Did you ever think why little American boys and girls know more stories about bears, and are more interested in bears than they are in any other wild animals? It must be because white children and bears are such old acquaintances. They have always lived near neighbors, both in the old world and in the new. In northern countries, where white people live, there never have been any lions or other big, flesh-eating beasts, so Mr. Bear has had the woods and

mountains and frozen oceans very much to himself. Besides, although he can kill deer and buffalo bigger than himself, he rarely attacks men unless they hunt him. If caught as a cub, he can be tamed and taught all sorts of cunning tricks. And he is so bright and does so many almost human things, that we rather like him, even if we are afraid of him.

Little Alex knew that "bears kin climb up higher in the trees than any little boys in all the wo-r-r-ld!" that the big papa and mama bears "*get mad*" if you bother their babies; that they think out new ways to escape traps and catch their enemies. So now, maybe this story is really true:

"Once upon a time, a Puritan boy who came to live in America was lost in the forest. He climbed a tall tree to look over the country to find himself. The tree was hollow to the bottom. Suddenly he slipped and fell into the well-like hole, and dropped plump onto something soft and warm and squirmy and grunty. He knew at once he had fallen into a bear's den onto the cubs, and was badly scared, for he couldn't climb out. 'Way, 'way up he could see a round patch of blue sky. Then he couldn't see it. The hole was corked like a bottle by mama bear coming home. He remembered that a bear always comes down backwards, just as a boy does.

"Down she scrambled, scratching and 'woof-ing,' and backed her hairy body right into the boy. He grabbed her shaggy coat and hung on for dear life, and screamed. Very likely the bear thought a wild cat was on her back. Wild cats have terrible claws, and the bear was where she couldn't fight. So she climbed up as fast as she could, and pulled the boy out of the hole. They both 'ran fourteen miles in fifteen days and never looked behind them.'"

That must have been one of the smaller black bears that used to be so common everywhere in American woods. The black bear is so bright that the Indians called him "brother." They never killed one purposely. The little Puritan boy was right in thinking that she would come down backwards as did the brown bear in the woods of England. Both of these land bears do many things like boys. They can stand up on their hind legs and "box" with the fore paws, as if they were trained in a school gymnasium. They can walk on the hind legs and carry a cub or a squealing pig in their arms, as your mama carries the baby. They eat meat only if they can get nothing better. Really they prefer blackberries, honey and nuts, just as children do. And—they make tracks with the entire

TWO BIG BROTHERS



Compare the big brown bear with the polar bears in Mr. F. G. R. Roth's statuary group. When winter comes mother polar bear lets the snow cover her and goes to sleep. Her breath opens a passage into the outer air. Toward spring her babies are born.

soles of their five-toed feet, that look like bare-footed men's tracks. The Indians were sometimes fooled by these tracks of Brother Bear. To the people of Northern Europe, who wondered over these human-looking foot-prints, the brown bear was called "the wise old man in the fur cloak."

Brown bear cubs always were easily tamed. In Northern Japan a people called Ainos fatten bear cubs for food. When small they play with the children, and are not shut up until they become big and rough. They are as playful as puppies. Hundreds of years ago trained bears were led by chains about the old walled cities of Europe, and made to dance and tumble and pull carts. Very likely bears, and many other wild animals, were tamer in the days when there were fewer people and bigger forests. In Yellowstone Park, in the Rocky Mountains, where hunters are not allowed to shoot or trap them, black and cinnamon bears come right up to the hotels in the woods to eat scraps from the table.

Mr. Thompson Seton tells all about these bears, and their bright and comical ways, in his story of "Johnny Bear." Johnny was a cub that worried his mama. He was an only child, and very much spoiled and peevish. He would poke his silly head into every sort of danger. He was so greedy he often had the stomachache, and he got his paws fast in tomato cans and jam pots. So, once she had to box his ears!

We can't all go to Yellowstone Park and take snap-shot pictures of bears from the hotel verandas, but nearly all of us can see them in menageries and city park zoos. There you can see black and brown, cinnamon, "grizzly" and polar bears. They all belong to one family, as you can easily see from their clumsy bodies, shuffling walk, shaggy coats and bear-y faces. But, in many ways, they are as different from each other as white, black, brown and yellow people.

The old world brown bear is the tamest of all. He will sit upon his haunches, cross his paws over his breast and catch peanuts in his mouth. Sometimes, when the band plays, he will dance and gambol about like a big, playful dog. The smaller, fine-coated black bear is friendly sometimes; but often he climbs the oak tree in his pit, folds his limp body across a big limb, like your mama's rug muff, and sulks or sleeps. You couldn't coax him down with a pot of honey! The big "grizzly" bear has an ugly temper. He sits back and snarls. Mr. Roosevelt says his real name is "Grisly," or horrid, and you believe it. He is a huge, ugly beast with long teeth and

long gray hair about his head. The big white polar bear, who weighs as much as an ox, doesn't pay any attention to anybody. He just prowls and prowls in an uneasy, lonesome way about his pit, until you feel sorry for him. His thick fur and fat body make him uncomfortable, very likely. When, on a hot day, a keeper gives him a ton of ice to lie on, he seems happier. If he turns his big paws up you can see that he is rough-shod, with hairy bristles all over the soles of his feet, for travelling on ice and snow.

Suddenly, for no cause that you can see, the bears in all the pits will shuffle over to the bars, rear upon their hind legs and "woof!" They smell the keeper coming with bread. Bears do not see very well out of their small eyes, and are rather dull of hearing, but they have wonderful noses for news, especially news of food and of enemies. If the wind is right, Mr. Wild Bear can smell a hunter and his gunpowder a mile away, and he gets out of a dangerous neighborhood as fast as he can travel.

He can travel fast, too. For all he is so clumsy he can run as well as he can climb. But he is not built for jumping, or for turning easily and quickly. Old hunters know this, so when a bear chases them they sometimes escape by turning sharp corners, or by zig-zagging. This puzzles a bear and wears him out. Hunters never climb big trees, for the bear can go right up after them. When they climb small trees bears have been known to put their big arms around the trunk and try to shake them down. Or they sit at the foot of the tree and wait. As little Alex says: "That bear 'ist won't go 'way, 'ist growls 'round there, an' the Little Boy he haf to stay up in the tree all night." Bears are clever about getting out of tight places, too. Here is a story about a clever bear that is told by a naturalist.

A dozen men were in the Rocky Mountains of Canada laying out a route for a new railroad when they saw a big cinnamon bear in a tree. He had gone up for honey or a squirrel's store of nuts, or just for a nap, perhaps. The men had no guns, but they had axes and crowbars, so they thought they could manage Mr. Bear. They chopped the tree nearly down, the bear lying still and watching them. When the tree began to fall he put his forepaws over his head, rolled up into a big ball and dropped. He upset some of the men and surprised the others so that he had time to scramble to his feet and run away. I shouldn't wonder if that bear was still laughing at those men.

Bears will not run from danger and leave their cubs behind. A cub can never be captured unless papa and mama bear are dead, or far away from home. They hide their babies very cleverly in caves, hollow trees or under old logs where they make their winter dens. They keep the cubs hidden there for weeks and months after they are born, for bear babies are as blind as kittens, as naked as little birds, and perfectly helpless at first. They are fed with milk at their mother's breast, so she stays with the cubs while papa bear goes foraging for food for her. Mama Bear is as cross—as a bear. You know that's as cross as any one can be. She will try to kill anyone who comes near her babies.

All wild animals are fond of their mates and babies, and will fight for them. But there are few that are as brave and loving as the polar bears. Explorers and whalers tell stories that make the tears come to your eyes. In that lonely waste of frozen land and water, a polar bear family seems almost human in their close affection. In the winter the mother and cubs stay in the warm cave, but the father cannot sleep all winter long as the land bears do. He must go out into the Arctic night for food. He watches seal and walrus holes as patiently as the Esquimo. He climbs icy cliffs. He is often carried out to sea on floating ice, and he swims back, miles and miles. In the summer the whole family hunt together. If one parent is killed the other will not desert the body. Neither will leave a dead or wounded cub, but will stand over it, lick the face and wound, pet it, coax it to get up, and will fight to the death rather than be driven away. They are terrible in their grief and rage.

There are three kinds of bears—land, water and honey bears. Of course all bears love honey, and will risk being stung on their tender noses to get it. But the honiest honey bear lives in the East Indies. In his Mowgli stories, Mr. Kipling has a honey bear that he calls Baloo. This animal is called the jungle bear because he sleeps in the shady jungle all day, and also the sloth, because he is so sleepy and moves about so slowly, and also the honey eater. He and the sun bear, who loves the sun as the jungle bear loves the shade, have long upper lips that look as if they had been stung by angry bees, and stretchy rubbery tongues. They can push this lip and tongue into an ant's nest and suck up a whole village with a greedy noise you can hear yards away. They eat bees and ants, ants' eggs, rice plants, fruits, honey and even flowers. In South

America are numbers of honey bears. Some of them climb cocoanut trees and drink the milk of green nuts.

These are about all the animals you know as bears, but there are several cousins of the bears who are all clever. They are famous climbers, diggers, fighters and swimmers. The raccoon or 'coon, that Southern negroes love to hunt, is the plucky little tree-bear. He is only two feet long, but he will fight a dozen dogs and sometimes get away. Here is something funny about the 'coon. He likes his food wet, or clean, or something. When he finds something to eat he takes it to a brook and washes it. In Germany the 'coon is called the washing bear. In a wild state the big bears do not seem to have this habit. But when the loaves of bread are brought to the pits in park zoos, all the bears roll it into the running water and soak it before eating it.

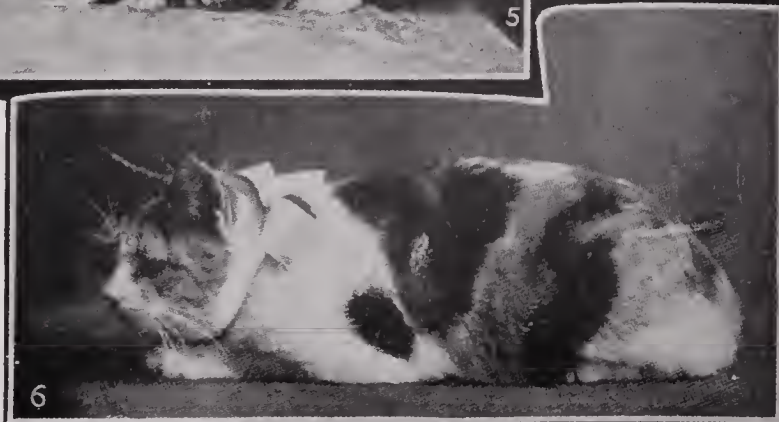
There is one thing bears are afraid of—guess! You never will. Mosquitoes.

Away up in Alaska where the biggest gold brown bear of all lives, and the glacier bear on the ice rivers, the summers are short and hot. There mosquitoes breed by millions on the vast swamps. The tip of a bear's nose is quite naked, moist and sensitive, like a dog's. He needs it that way for smelling. And, of course, his eyes have little protection. The mosquito swarms in clouds about poor Bruin and sting and sting him. He can fell a buffalo with one box of his big paw, but he cannot fight these little pests. He just turns tail and runs!

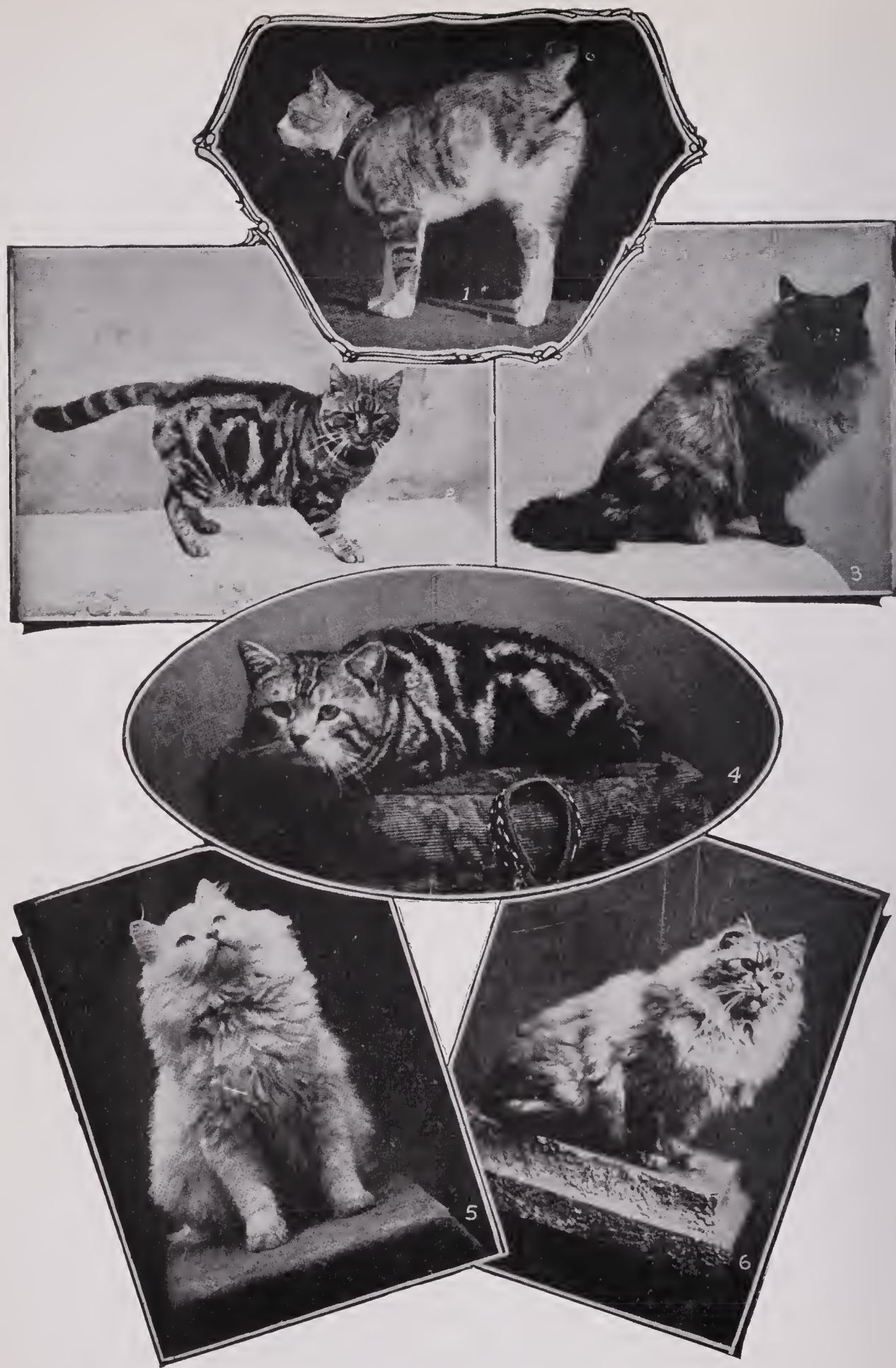
Long, long ago, the people in a far-away cold country called Finland had a beautiful story about the bear. They called him Otso. This story was put into verse like that of Hiawatha, and sung by mothers to put children to sleep:

Otso, thou, O forest lover,
Bear of honey-paws and fur-robcs,
Learn that Waina Moinen follows,
That the singer comes to meet thee;
Hide thy claws within thy mittens,
Let thy teeth remain in darkness,
Mighty Otso, much beloved,
Honey-eater of the mountains.

Isn't that a pretty song of Brother Bear? Maybe that's why you like to take Teddy Bear to bed with you.



1 White Persian 2 Light Silver 3 Cream Persian 4 Siamese 5 Silver Persian
6 Short Hair Tortoise Shell



1 Manx 2 Brown Tabby 3 Smoke Persian 4 Silver Tabby 5 White Persian 6 Shaded Silver

II. PET PUSSY AND KING LION

Men have known lions longer than they have bears. They have lived right next door to lions for thousands of years, but they never called a lion "brother." They never felt as friendly as that toward this fierce, proud beast. He has always been King of the dry plains of Africa and the hot jungle of India. In the menagerie and zoo he keeps everyone at a distance, and seems to feel very much above all the other animals, and even men. If he could understand that he has a cousin so small, so tame, and so playful that little children make a pet of him, he might just roar with rage and shame

The lion is only a very big wild cat. Your pet kitten is like him in more ways than you imagine. In fact, pussy is a live and lively book on lions. Live books are better than printed ones, and much more interesting. Pussy walks and runs and crouches and springs exactly as a lion does. She watches a mouse hole and springs on her prey as a lion does, too. Turn her on her back and look at her paws. There are five toes on her front paws, one of them a sort of thumb, but only four toes on her hind paws. Did you know that? On each toe is a little curved toe-nail, as sharp as a little sickle. Pussy keeps her claws inside her pretty, soft fur mittens most of the time. But she can push them out as quick as a wink, pull them back again and scratch exactly like a lion. Under the toes and the balls of the feet are soft, naked cushions, so pussy makes no sound when she walks. All the wild cats—the lions, tigers and leopards, the jaguars, panthers and lynxes have feet just like the house cat's.

Now look at pussy's head. She has upright, outward-turning ears. She must hear well because she hunts at night. On each side of her mouth are long stiff hairs. These are feelers to keep her from putting her head into a smaller hole than her body can go through. Her eyes are the strangest of all. There are windows, or pupils, in them, for letting the light in, as there are in your eyes. In the dark these windows are big and round, so they shine like little yellow moons. But in the daytime, or in a lamp-lighted room, those pupils close to a narrow, up-and-down slit to keep the light out. Pussy can see in the dark so well because she can open her eye-windows so wide. Some of the lesser wild cats shut the pupils of their eyes

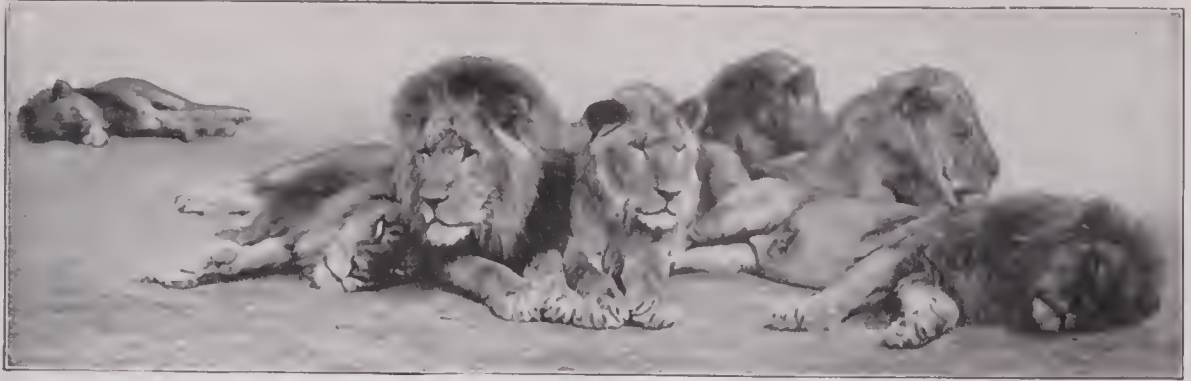
to slits, but the lion, tiger and leopard draw their pupils up into little round holes. In that one thing the lion is more like boys and girls than pet kittens.

Put your finger in pussy's mouth. What sharp teeth she has. They pierce like the points of carpet tacks. When she licks your hand her tongue feels like a file. A lion's teeth are like daggers, and his tongue is so rough he can scrape bones clean with it. Lions lap water with their tongues, too. Pussy doesn't like to get her feet wet, and lions just hate water, except to drink. That is queer, for many of the wild cats love water. The tigers of India swim across small arms of the sea. They haunt river banks and swamps, wade in up to their necks to drink, wallow in the mud, then wash off and roll in the sand. This love of water gets them into trouble with crocodiles. The jaguar, or South American tiger, likes turtles and catches them by swimming.

All the wild cats wash their faces with their paws. Perhaps you have wondered why your big cat likes to go to a quiet, shady place and sleep a good deal in the daytime, and then prowl about and make dreadful noises at night. She learned that habit thousands of years ago when all cats were wild, and she never quite gets over it, no matter how tame she seems. She will try to hide her babies, too. On farms, where there are fine hiding places, mother cats will make a den under the barn floor, in the haymow, or in a hollow log up in the woods. If you try to follow her to find her kittens she will mislead you in the cleverest way. The mother lion carries her kittens by taking the loose skin at the back of the neck between her teeth, just as the house cat does.

The lion makes his den in a rocky cave hidden by bushes, on the edge of a wide sandy plain where many antelopes, deer, zebra and other grazing animals roam. In one thing he is better than the house cat. When he is about three or four years old, and has a short, fine silky mane, of which he is as proud as big brother is of his downy mustache, the lion picks out a mate to go to housekeeping. These two stay together just as human papas and mamas do, all their lives, and they sometimes live to be fifty years of age. When they find a house that suits them they don't like to move. You know tame cats like places better than they do people, and often refuse to go with the most loving little mistress to a new home.

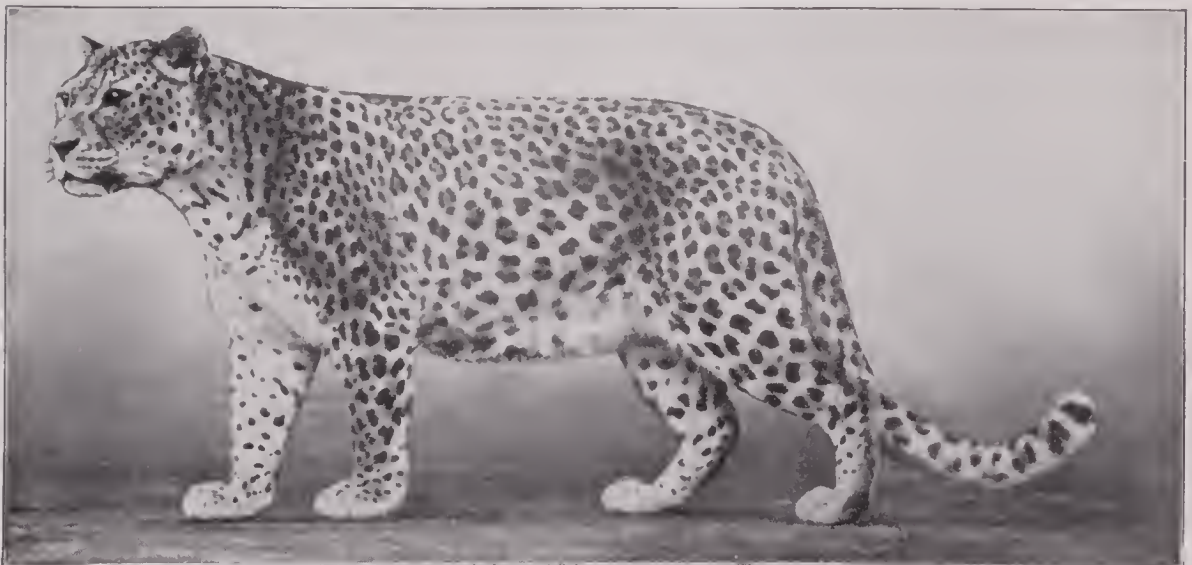
There's one thing that lions can't do that cats can. They can't climb trees. But tigers, leopards, panthers and all the other big,



A GROUP OF LIONS.



ROYAL BENGAL TIGER



LEOPARD.

wild cats are great climbers, so it must be that lions have lived so long where there are few trees that they just forgot how to climb. The lion has forgotten to have stripes, or spots, too. His coat is of a uniform yellowish-brown, the color of sand and dry grass. All the other wild cats, and many tame ones, have beautiful markings. The tiger is banded in black and reddish fawn. The leopard is covered with big black polka dots on a golden fawn ground. The jaguar, or South American tiger is dot-in-a-ring spotted. But here is a curious thing. Although the grown up lion hasn't a sign of a spot or stripe about him, lion cubs often show faint markings that disappear as they grow older.

Scientists tell us that the young of many animals show, in some such way, how their ancestors looked ages and ages ago. Once, perhaps, there were no lions, as we see them today, only big striped and spotted cats that slowly changed into lions because of the open plains they had to hunt on. In the dancing sunspots and shadows of the leafy jungles, and in the foliage of thick trees, the tiger and leopard are safely hidden, but on level, treeless, brown plains they could be seen a long way off. But, while he had to paint out his spots and stripes, the African lion grew a beautiful dark mane that makes his head appear much larger, fiercer and nobler than that of any other cat. He grew a tuft of hair and a horny cone on the tip of his tail to lash himself into a rage. And he grew a terrifying roar, too!

Maybe you have heard a big African lion roar in a zoo. You can hear him a mile. That roar starts all the other animals. The tiger screams, the jaguar cries *piouw!* something like pussy's *meouw*. The bear "'ist growls," the buffaloes bellow, the elephants trumpet. All the fierce, fighting animals are thrown into a rage by that roar, and the timid ones tremble with fear. Some of them run, but others seem unable to move.

Maybe that is why the lion roars when he is on the hunt—to paralyze his prey with fear. He lies on the bank of a stream waiting, as pussy waits at a mouse hole, for some timid antelope, whose only safety is in his heels, to come down to drink. Then he springs with a roar. The way he roars in a zoo isn't *anything* to what he can do in the roaring line at home. He has several kinds of roars. Sometimes he moans like the wind in the tree tops. Sometimes he rumbles like faraway thunder. Sometimes he gets his neighbors to help him give a desert concert on a dark, stormy night. But it is worst of all when one party of lions meets another and they all roar at

each other for hours. You know what a dreadful noise cats can make when they quarrel on the back fence. Lions act the same way, only worse, and they can be heard miles and miles.

Ostriches must admire the lion's roar, for they seem to try to imitate it. African travellers say they do it very well, too. Hunters can be sure of one thing. A roar at night means a lion; a roar in the daytime an ostrich.

Did you ever see a cat miss catching a mouse? She looks ashamed of herself. She peeps around to see if any one noticed her failure, and slinks away as if she wanted to forget it. Lions do the same. And they do not attack elephants and other big, thick skinned, tusked animals that fight back. Nor do they attack men, unless they are wounded or driven into a corner, or sometimes when the man is asleep and helpless and the lion very hungry. Some African travellers say that if a man meets a lion, all he has to do is to stand still and look him square in the eyes and Mr. Lion will back away, then turn tail and run. I wouldn't like to put that to the test, would you? But a lion is used to seeing animals run from him in fear. It might puzzle him to see a man stand still and stare at him. Wild animals are a good deal like human beings in that. They are afraid of what they don't understand.

Travellers say the lion isn't nearly as brave as the tiger, nor as noble as he looks. He slinks along through tall grass, or behind bushes with his head hanging below his shoulders. He never fights any animal that can defend itself unless he is forced to do so. The only time he shows great courage is in defending his mate and cubs, and then the lioness is fiercer than the lion. In captivity, of course, he is savage. He thinks of himself as in a trap, very likely, and that every man who comes near him wants to kill him. That makes him very dangerous.

How do you suppose this big, bearded wild cat is ever tamed so far that he lets his trainer use him for a pillow, drive him to a cart, play see-saw with him, wrestle with him, and jump through a hoop at a word of command?

The training of a lion is simple. He has to be made to understand two things. One is that his trainer is his friend and means to use him well. The other is that the man is master. The trainer begins by going up near the bars, talking to the lion kindly, and throwing him some meat. It isn't long before the lion learns to know and to watch for the man who feeds him. Next the trainer,



PAINTED BY WILLIAM A. DRAKE, A. N. A.

ON GUARD

'Don't you dare hurt our babies or their mama,' King Lion seems to say. He is a good papa. Besides guarding his mate and their babies he helps her get food for them and teach them how to get food for themselves. There are usually three babies in a lion family.

while talking, puts a stout stick between the bars. With a terrible roar the lion springs on the stick and crushes it into splinters. But the trainer keeps right on putting sticks between the bars, talking kindly to the lion and feeding him. After a few weeks the lion pays no attention to the stick, or he smells it and walks away. Finally he lets the trainer touch him with it, and stroke his back as he eats.

It is several months before the trainer tries going into the cage. He takes the stick with him and a stout chair. He sits down and pretends to read a newspaper. The lion crouches back in a corner and growls. If he should spring the trainer has the chair up, legs out, before his face, and Mr. Lion gets a bumped head and a blow on the nose—his tenderest spot. Very slowly he learns to trust his master and to fear him, too. Sometimes a lion seems to grow fond of his trainer.

When petted he will purr as if he had a whole swarm of bees in his throat. But trainers never forget that the tamest lion is always dangerous. He is sly and treacherous, too. Without an instant's warning he may forget all his lessons and turn on his best friend. So the trainer watches and watches, never quite trusting even a lion that he has brought up from a cub.

Lion cubs are the cunningest babies. They really look and act more like puppies than kittens. They are as fat and clumsy and woolly as Newfoundland puppies. In Lincoln Park Zoo, Chicago, a keeper takes a family of three or four lion kittens out onto a grass plot for a romp. Crowds and crowds of people watch them tumble over each other. They are not born blind as tame kittens are, but they are just as helpless, and for a long time cannot even lap milk from a saucer. Sometimes the mother lion, soured on the world by being shut in a cage, won't have anything to do with her babies. They die unless some other animal with milk can be found to nurse them. The very best foster mother for lion kittens is—not a cat, but a dog. A shepherd or collie dog is the best, for she is trained to care for sheep. She nurses them, fondles them and seems as proud of them as a mother. But in a few months they grow so big and rough that she looks at them in wonder and alarm, as a hen looks at a duckling she has hatched to take to the water. She must think the fairies have changed these babies in their cradles, for they are none of hers! And by the time they are old enough to be weaned they are too much for doggie.

III. HERE COME THE ELEPHANTS!

That is what the children shout when a circus parade marches through a town. The elephant is the children's delight. Draped in purple and gold he walks with the tread of an emperor before a conquered army. All the other wild beasts are in cages, but he, the largest and strongest of them all, a three-ton mountain of an animal, is led by his keeper as if he were a big, good-natured dog. And oh, if there is a baby elephant the children just about go crazy.

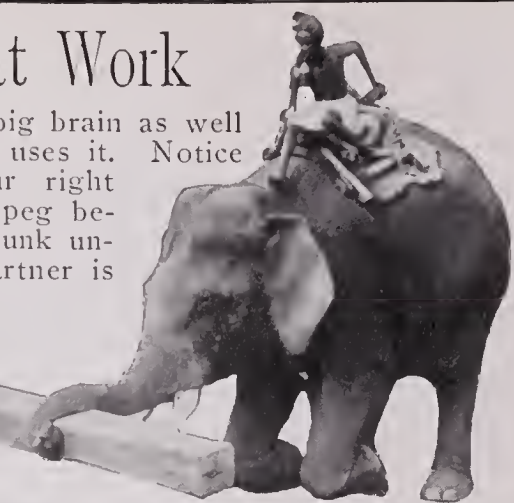
No wonder! Baby elephants are scarce. Even in her home on African plains, or in the East Indian jungle, a mother elephant has a baby only once in ten or fifteen years, so there are never more than a few babies at a time in a big herd of a hundred or more elephants. It's a great event when one is born in captivity. Such a baby! He weighs two hundred pounds at birth, is nearly three feet high and has a funny little trunk about as long as your twelve-inch ruler. And you never saw such a baby for growing! At the age of one year he weighs a half a ton. When he is hungry he squats in front of his mama, spreading his hind legs out behind him, pokes his head up between her *front* legs and sucks milk with his mouth, just like a calf. She pets him with her trunk while he nurses, and she doesn't wean him until he is two years old.

A baby elephant is as solemn as an Indian papoose. But in his own clumsy way he is very playful. He plays hide-and-seek between his mother's legs, and pulls her foolish little tail with his trunk. When anything alarms him, he gets right under her and shuffles along that way. And when she crosses a stream he climbs on her back until he learns to swim. In one thing he doesn't get over being a baby until he is a grandfather. He spends half his life cutting new teeth. An elephant has twenty-four grinding teeth in all, but he cuts and uses only four at a time. As one set wears down a new set appears just behind. Maybe it is cutting teeth that makes a big, fifty-year-old elephant peevish, sometimes.

There is a secret that a very young baby elephant can tell you that even his mama doesn't know. Ages ago there were elephants and mammoths and mastodons that were much like them, only twice as big as any elephant living today. They lived all over Europe and America, some of them away up in the coldest countries where

Elephants at Work

The Elephant has a big brain as well as a big body, and he uses it. Notice how the one on your right kneels and seizes that peg because he can't get his trunk under the beam as his partner is doing.



GOOD TEAM WORK

We are piling teakwood beams in Rangoon, India—my partner and I.

I pick up a little one like this all by myself, stand it on end against the pile,

then lift it on my tusks and slide it into place—so:

EMPERORS OF INDIA

Elephants passing reviewing stand at the Durbar—the great ceremony at which England's king is declared Emperor of India.



"Draped in purple and gold, he walks with the tread of an Emperor before a conquered army."

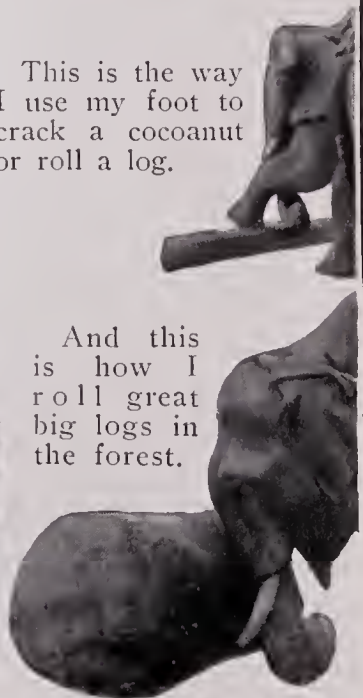
This is the way I use my foot to crack a cocoanut or roll a log.



ANOTHER WAY OF MOVING BEAMS

This is how we push beams along the ground with our tusks. My partner is letting me be the whole show while you are watching us.

And this is how I roll great big logs in the forest.





A HERD OF WILD ELEPHANTS

Captured and placed in a strong pen. After they have become somewhat tamed they are lassoed and taken out separately

polar bears live today. They were covered thick with wool and hair, and had long hairy manes like those of the buffaloes, falling over huge curved tusks twice as long as a tall man. Today, you know, elephants havn't a sign of a hair on them. Their thick gray hides are as bare as rubber blankets. But baby elephants, when first born, have a scanty covering of silvery brown wool all over their pink, piggy skins. That tells very plainly of a time when all elephants had fur.

It takes an elephant thirty years to grow up to eleven feet in height, twelve in length, with tusks and trunk six or eight feet long, and a weight of three tons. He has plenty of time, for, if he is lucky, he may live to be a hundred or more years old. The hide of a full grown elephant is an inch thick, and full of folds and creases and wrinkles. The ears of an African elephant are as big and floppy as rubber door mats. He can smell as well as a dog or a bear, and see and hear much better. His legs are as thick and solid as the pillars under a portico, and his feet are scolloped with five thick toes around a pad. An elephant's knees and elbows are so near the ground that it is hard for him to get up and down. He can't curl his legs under him as many animals do, but kneels and sprawls his hind legs out behind. Sometimes he seems to say: "What's the use in trying to lie down at all?" So, when he is sleepy, he just leans up against a big tree, or a rock. And he has a stiff neck all the time. His neck is so short and thick that it is very little use for turning, although he can toss his head up and down like a bull.

For such an e-nor-mous animal the elephant is wonderfully active. He can shuffle along, in his clumsy way, nearly as fast as a horse can run. East Indian elephants climb steep mountains as pack animals, and are very sure-footed. All elephants are good swimmers and hard fighters if attacked. They can charge the enemy like cavalry horses. Their tusks are terrible weapons, and no other animal living has such a wonderful tool-chest as the elephant's trunk. It is a nose to breathe and smell with, an upper lip, a finger and thumb, a stout arm, a water tank, a club to fight with, and a musical instrument all in one. As hollow as a garden hose, that trunk is made up of forty thousand muscles laid length-wise, cross-wise and on the bias, in a net-work that gives it great strength and variety of motion. With its trunk the elephant can pick up a peanut, pet its baby, pull a small tree up by the roots, give itself a shower or dust bath, break off a leafy branch and shoo away the flies, slap

a saucy tiger senseless, and bellow like the bass horn in a brass band.

But *why* is it called trunk?

Don't you suppose nearly every little boy and girl in the world has asked that question? And got an answer something like this: "Oh, just because it is." But that is no answer. The name is really *trompe*, a French word meaning trumpet, for the trumpeting sound the animal makes. English people misunderstood the word and changed it to trunk. Besides it looks like the stem or trunk of a small tree turned upside down; and there is a hollow tube for forcing pellets through, something like a pop-gun, that is called a trunk. So trunk seems just about as good a name as *trompe*, doesn't it?

Elephants live in herds like buffaloes. There are from twenty-five to one hundred in a herd. They wander about together in the woods and on the open plains of Africa and India, wherever there is plenty of grass, low plants and trees, near water. They sleep in the forest. As early as three o'clock, long before the sun rises, a herd is on the march. They go in single file, the big bulls in front breaking a path through the thickest jungle. Then come the cows, and last the mothers with babies. This is the order in which Indians travel, the warriors ahead and the children in the rear.

If danger threatens, the bulls trumpet a warning. All the others stop, and the bulls line up to give battle to the enemy. Some people think that only the flesh-eating animals are dangerous. This is a mistake, as you must know when you remember how savage some bulls of domestic cattle are. African bull elephants are so fierce the lion tucks his tail between his legs and slinks away, when he hears one trumpeting. The tiger sometimes attacks the smaller East Indian elephant, and often gets the worst of it.

African explorers and travellers say a charging bull elephant is a grand and terrible sight. He blows his mighty trumpet in a blast that can be heard for miles, lowers his head with its six foot tusks, and tosses his trunk up out of danger. He knows how easily that precious member, all delicate muscles and nerves, might be injured by claw or spear. When a tiger springs, the bull catches him on the tusks, tosses him twenty feet in the air, gives him a swinging blow with the trunk as he comes down that stuns him, then pins him to the earth with the tusks, or tramples him under his three tons of weight. It is said that every pair of tusks brought out of Africa has cost one or more human lives.

Usually a herd marches to the feeding ground unmolested. There they pull the grass up by the roots, beat the earth off on their front legs, give the bundles neat twists, and poke them back into their mouths. They pull up bushes and break off high leafy branches. They even uproot small trees, prying with the tusks and pulling with the trunks. Cocoanuts are cracked and shelled by rolling underfoot. They are fond of palm nuts, sugar cane and yams, a kind of sweet potatoes. In captivity elephants are fed on hay and carrots, but they just love peanuts, popcorn and candy. A herd of one hundred wild elephants will eat ten tons of food a day.

About sunrise the whole herd takes a bath. They go on a shuffling run to the nearest "ole swimmin'" hole. Into the water they go up to their eyes. They frolic like so many school boys, shouting at the tops of their—trumpets, slapping and splashing water over each other. The babies ride on their mother's backs, slide off and learn to swim. Often a herd plays in the water for an hour. Before coming out they suck up as much as ten gallons of water each, through the hollow trunks and stow it away in water pockets in their stomachs. Later in the day, when they want a drink or a shower bath, they bring this water up and use it. The camel seems to be the only other animal that has storage tanks inside for water.

Old hunters in Africa and India say members of a herd look alike as do members of a human family. Some herds are made up of animals that are large and strong and bright minded. In other herds the animals are smaller, weaker and more stupid. In East India the natives speak of elephants as low caste and high caste, and say there is as much difference as there is between breeds of dogs and horses. And no hunter will go after a "rogue" elephant. A "rogue" is a tramp elephant. For some reason he has left his herd, or been driven out. No other herd will admit him, so he turns sour and becomes very dangerous, fighting every living thing he meets, and destroying what he cannot eat.

Elephants hate flies. The flies and stinging insects of hot countries are large and thick and tough as is the elephant's hide they manage to get into the folds and creases and sting him. He fights his tormentors with shower and dust baths and fly brushes. When they drive him frantic he rushes into the water to wash them off. There he finds a friend. It is the long-legged water crane who stands on the elephant's back and picks out the flies to eat. Some-

times this feathered friend and a baby elephant may both be seen riding on Mama Elephant's back.

Of two things the elephant is afraid—fences and mice. A fence looks like some of the traps used by native tusk-hunters. The flimsiest fence of reeds, bamboo or barbed wire will usually keep a herd of hungry elephants out of a sugar or yam field, or will keep them prisoners inside a stockade. As for a mouse, very likely the elephant thinks it a big insect that will run up his trunk. He throws the trunk up out of danger, bellows with rage and trembles with fear.

The huge African elephant is very wild, hard to tame and teach, and is of uncertain temper. Even the cows have tusks. A good specimen is not often seen in a menagerie. Your papa and mama will remember Mr. Barnum's famous African elephant "Jumbo." The East Indian elephant is smaller, more easily captured and tamed. He readily learns to do useful work and to perform tricks. He becomes fond of a kind master, and likes children, dogs and peaceable animals. He is not brighter than the dog, but because of his size and strength and his wonderful tusks and trunk, he can do a great many things that a dog cannot do. In India, the elephant piles half-ton teak logs in lumber yards, and is used in the timber and stone work of roads and bridges. He can push a cannon across a bog, carry a load over a mountain, and help sportsmen hunt and kill tigers. East Indian rulers all have troops of elephants to use in warfare, and to ride in royal processions. In Siam, the white elephant is a sacred animal and has a place on the national flag.

How old and wise the elephant in the menagerie looks. It is very comical to see such a heavy, clumsy animal stand on his hind legs or his head, dance to music, blow a horn, beat a drum, ring a bell or fire a gun. He kneels to let children and dogs and monkeys climb into a canopied throne on his back, then rises and takes them for a ride. He plays see-saw with another elephant, forms pyramids, rolls barrels, piles boxes and does many other hard things. The elephant has a good memory. He never forgets a trick he has once learned. He remembers an unkindness for years, and is sure to watch patiently for his chance, and to take terrible revenge on a keeper who mistreats him.

Hundreds of years ago the Greeks and Romans trained elephants to perform in their open-air circuses. Ancient writers tell of elephants that rocked cradles of babies whenever they cried, and of others that walked and danced on tight ropes. One writer says that

elephants were sometimes found practising their tricks at night, because they liked to do them, perhaps, or because they had been punished for not performing properly and wanted to know their lessons better. That seems hard to believe, but some trainers of today say they have watched these huge animals saying over their lessons out of school.

Don't you think these clever animals deserve all the petting and peanuts they can get? Some elephants will eat right out of a child's little hand. But you should always ask his keeper if it is safe to feed an elephant in that way, and what he likes best. And be very careful not to touch his precious trunk.

IV. THE ANIMAL ACROBAT AND CLOWN

Can you think of anything that will collect a crowd of children so quickly, or keep them happy so long as an organ grinder with a monkey?

The music is often very dreadful, but the monkey is very funny. His tiny wrinkled face is so comical. It looks like that of a wise little old man who has seen a lot of trouble. Like a good clown in a circus, a monkey doesn't have to do anything to make people laugh—except just *be* a monkey. He is so wonderfully agile, quick and clever. He mimics everything people do. He "makes faces," he dances to music; he runs up the telegraph pole, a tree or a porch pillar, and he swings from bars like a trapeze performer. He picks up pennies, stuffs them in the pocket of his absurd red jacket, and pulls off his collar-box-cap for thanks.

It seems a pity that a monkey can only chatter or scream or scold, for he tries ever so hard to talk. Such a mischief he is, too. If he sees a chance he will snatch a little girl's doll or a lady's hat and tear them in pieces. He knows very well such behavior is naughty, for he scrambles out of reach of punishment, and chuckles with glee over the trick. It's easy to forgive the little rascal, for the next instant he does something engaging. He cuddles his baby, or cracks a peanut like a squirrel, turns a hand-spring for you, or slyly pulls another monkey's tail.

Just what *is* a monkey?

In the big cage in a menagerie or zoo, there are a dozen or more varieties of monkeys as unlike each other as a fox terrier is unlike a St. Bernard dog. Some monkeys are as small as chipmunks, and others are as large as cocker spaniels. There are monkeys with long curly tails, with straight tails, bushy tails, stub tails, and no tails at all. Some have very hairy, and others nearly naked faces. There are dog-faced and purple-faced monkeys; monkeys with white cheeks, with turned-up noses, with tufted ears, with whiskers, mufflers and bonnets. Most of them are black, gray or some shade of brown, from silver-fawn to seal. But there are dandified monkeys with green coats and orange vests.

Many people call all the big apes—the gorillas, chimpanzees, orang-ootans, baboons and gibbons, monkeys. But we won't do

HOW CLEVER THESE MONKEYS ARE!

THIS trained monkey is named Susie. She was brought from monkey-land and taught to pick up a cube, a ball, a cylinder and other shapes just as if she were in a kindergarten. Her big, wild relation (1) is climbing through the tree tops with her baby. Figures 2, 3 and 4 show how these "acrobats" swing from tree to tree.



Here Susie is asked by the little boy to pick out various colors of cloth. Her owner is snapping his fingers to get her close attention. Monkeys are like little people—they do best when they pay close attention.

that. These huge, man-like creatures from the Old World are savage, and have to be kept separately in strong cages like other wild beasts. They are hard to catch, hard to tame, and harder to keep alive in captivity, so you will not often see one. By monkey, children always mean one of the smaller apes that can be tamed easily and led about by a string like a little dog, or kept with many others in a big room of wire netting and bars.

A monkey in captivity is happier in a cage with a number of other monkeys. "The more the merrier" is the rule in monkey land. Nearly every kind of small ape lives in a monkey village in the trees, when he is at home. There is a wise old male for a chief. He and the older males keep trespassers away from a chosen feeding place, and he leads them to a new home when they move. Early in the morning and late in the evening, seems to be play-time in a monkey town. All the monkeys leap and swing and chase each other, and "whoop and holler" as Riley says, like so many boys playing in the woods. Spoiled boys they are, too, doing a great deal of mischief by throwing down cocoanuts and other fruits and nuts, just to see them fall.

Some of these monkeys have the prettiest homes! They camp out all the year round. They love the dense woods of very hot countries. In the beautiful tropical forests along the Amazon River, in South America, monkeys live in bowers in the trees, among red and green parrots, butterfly orchid blossoms, brilliant birds and insects and flowering vines. They live in thousands of tropical islands in the sea, among palms and fruit trees. But a few are found in colder countries: in Mexico and in the mountains of India, Japan and Northern Africa, and even around the great fortress rock of Gibraltar, in Spain.

No matter how much monkeys may differ in other things, they are all alike in having four hands. The bear, the lion, the elephant, the dog—nearly all the animals you can think of, have four feet. Little girls and boys have two hands and two feet. A foot has a long sole and short toes, usually, and the toes cannot grasp and hold things. A hand has a nearly square palm, fingers much longer than toes, and a thumb. In the best kind of a hand the fingers and thumbs have three joints each, and can all be brought together in many positions, and even closed into a fist. All four of a monkey's feet, that he walks on, are really hands, with grasping fingers and more or less perfect thumbs. That is why a monkey is so clumsy

on the ground. Usually he walks on the outside edges of the palms with the fingers and thumbs curled in. This gives him a funny, bow-legged look. But just watch him on a tree or a perch, or clinging to the wires of his cage. He's as much at home in a tree as a bird or a squirrel.

Even if a monkey cannot talk, he can tell you very plainly where he lived when he was at home—that is, whether he is an Old World monkey from over the ocean, or a New World monkey from South America. The monkeys in a Zoo always come to the netting when visitors appear, for they are very curious and want to see everything that is going on. Besides, they have learned that some 'specially friendly little boys and girls carry bags of peanuts. Select any little fellow who comes up to you and give him peanuts, one at a time, as fast as he can take them. If he is an Old World monkey he will stow those nuts away in cheek pouches like a squirrel. He can put a surprising number away, for those pouches stretch and stretch like little rubber balloons. Look at him carefully. His nose, of course, is flat, but the two holes are near together. And when he goes up to a bar to eat his nuts, he does not use his tail in climbing.

A South American monkey's nostrils are far apart. He has no cheek pouches, but heaps as many nuts as he can carry in his two front arms, as you carry packages. But he can keep other monkeys from taking his nuts when he climbs, for he uses his long, curly-tipped tail for a fifth hand. With five hands for grasping the South American monkey is a wonderful trapeze performer. The tree-squirrel climbs faster, the flying squirrel leaps farther, the bat clings better with his wing-hooks, but no other animal can climb, leap and swing, and go across a wide forest, forty feet from the ground without once coming to the earth. The acrobat of the animal world, he seems to be made up of wire springs that are tireless.

The South American monkey that you will see oftenest with the organ man is a small, rusty brown animal about as big as a toy terrier. He has a curved hair-covered tail, good thumbs, a rather pleasant whistling chatter, and a care-worn anxious face, as if he expected nothing in life but bad news. He is bright and obedient, so he soon learns his tricks and performs them willingly. He likes to ride on a dog's back, his master's shoulder or the barrel organ. Another favorite of the organ man's is the Capuchin monkey. You may know him by the queer way in which the hair grows around his face like a hood or Capuchin monk's cowl.

Sometimes in school you learn a rule, and then the teacher will tell you that there are times when the rule doesn't work. The marmoset, the smallest and prettiest of all South American monkeys, cannot use his tail in climbing. When children see the marmoset they always cry: "Oh, what a little dear!" He is no bigger than a chipmunk. He is only eight inches long, with a furry body and a foot-long bushy tail that he carries like a plume. If it wasn't for his almost human little face and hands, and his wing-like, tufted ears, you might think him some kind of squirrel.

There is a squirrel monkey from South America only a little larger than his nut-cracking namesake. He has a gray face and a black nose, but has long hind legs so he leaps something like a kangaroo. When he is happy he shows it by grinning, and when he is hurt tears come into his eyes. In his home in the Amazon forests it rains torrents sometimes, as if the bottom had fallen out of the clouds. When caught in such a storm, a troop of these squirrel monkeys huddle together in the thickest tree they can find, and put their tails around each others' necks for company and comfort.

These marmosets and squirrel monkeys have some of the noisiest neighbors—the howling monkeys. They begin howling at sunrise, keep it up until the next sunrise, and then take a fresh start. The woods ring and echo with their howls. They travel all the time through the high branches of the trees, the males leading, and the mother monkeys following, each with one or two babies clinging to her neck with fingers and tails. They swing by their tails and catch the next limb with a hand. The brown howler is bad enough, but the red howler makes the night hideous with his cries. They screech as if all the animals in the forest were eating each other up. Some zoos won't have Little-old-man-howler, as he is called, at all.

Another South American monkey is the Saki. He has a ruddy back, and an almost human habit of cupping a hand and dipping up water when he wants to drink. He is so delicate that he seldom lives long in captivity, so you may never see him. But you are sure to see the spider monkey. He has such long slim arms and tail, and such a small body that he looks like a big, hairy spider. But really he is very gentle and even affectionate. He has little stumps of thumbs that are of little use to him, and he is not as agile as many other monkeys. A mama spider monkey likes to sit down and cuddle her baby in her arms.

So many of the Old World monkeys have only little stubs and lumps of thumbs that scientists put them all into one family called the colobus or cut-off-thumb monkeys. If you see a monkey with a very fine, long-haired silky coat, particularly if he has cheek pouches and makes no use of his tail, look for shrunken little thumbs. His coat makes pretty monkey-skin collars and muffs. One colobus of the mountains of Abyssinia, where it is cold, looks as if he were wearing furs himself. He has a fringe of white down either side his jet black body, a white tippet under his chin, a white edge to his cap and a white tip to his tail.

Another colobus of the hot west coast of Africa wears the hair on top of his head in a crest, with a parting on each side, something like grandma used to comb your papa's top hair, in a long fat curl called a "roach." This crested colob looks very comical, indeed, for, beside his roach, he has whiskers under his chin. A near neighbor of his in the African jungle is the "face-maker." He is a very good-tempered, teachable little fellow. The variety of queer faces he can make always draws crowds, so he is a favorite with the organ man.

Among the brown and gray and black monkeys in a zoo, you will be sure to notice any that are brightly colored. There is a red and a purple-faced monkey; a Diana monkey, with a pretty white crescent like a new moon on the forehead, a white beard and neck scarf, and a monkey with a blue mustache above yellow whiskers. He is called the mustache monkey. The green monkey is quite a dandy. He is dressed in dark green and black, set off with dull orange whiskers, throat band, breast-plate and tail-tip.

At first sight the Hoo'noomaun monkey of the East Indies doesn't look especially interesting. He is a little grayish-brown, spider-legged animal with black hands and face. But he is a privileged being. In his native land he is sacred to Hoonoomaun, a monkey-faced god. He is never interfered with, so he goes in troops into the villages, helps himself to grain, fruits and nuts in shops and houses, and destroys things from wanton mischief. The people of India are so kind to all living creatures that several "bad boy" monkeys are very troublesome. Stories are told of a whole tribe of the Hoonoomaun or Rhesus monkeys swarming into dining rooms and eating wedding feasts. Another mischievous monkey is the magot who lives in Northwestern Africa, and in Spain around Gibraltar. He is about as big as a terrier dog. He and all his relations go to a fine garden and set sentinels in trees and on rocks to watch, while the

others eat and destroy melons, figs, grapes, oranges and almonds. An alarm sends them flying. This bad habit lands many of them in zoos and travelling shows, because traps are set for them.

The street strollers of India, Japan and Northern Africa lead about the macaque (ma-cake') or bonnet monkeys. The hair of the macaques grows in a frill around the face. These sunbonnet babies are quick and clever. One of them loves crabs so well that he has learned to swim and dive for his favorite food. The pig-tailed bonnet monkey of the East India Islands is used on plantations to climb up the tall palms, where men cannot go, to pick cocoanuts.

Now there is one very sad thing about these amusing little creatures, or rather there used to be. Tropical animals, as most of them are, they very seldom lived over the first winter in our colder country. Like human beings they got tu-ber'cu-lo'sis (consumption) or pneu-mo'nia, or some other lung trouble, and died. Steam-heated houses were built for them to live in in the winter, and every breath of cold air was shut out. They seemed to die all the faster. Every spring the monkey cage had to be restocked. When the doctors found out that people with tuberculosis often got well if they lived out of doors, even in the coldest weather, Mr. De Vry, the animal keeper in the Lincoln Park Zoo of Chicago, thought he would try the fresh-air treatment on the monkeys. One fall he fed his monkeys more good food but left them out of doors. See what happened.

They shivered and had to jump around very lively to keep warm. You know it is sometimes *awfully* cold in Chicago, with freezing winds and smothers of snow right from the Rocky Mountains. The monkeys lived and thrived. Their bodies grew fat, their furry coats long and thick. In the spring more than half of them were alive and well. *And!* Wonder of wonders!

In the cage were several mothers, each with a baby cuddled in her arms. Never before had a baby monkey been born in captivity in a cold climate. They lived, too, and frisked about as if they were in the hot forest along the Amazon, instead of on the bleak shore of Lake Michigan. In the Lincoln Park Zoo, now, are monkeys several years old; and all big zoos and menageries have learned to turn their monkeys out of doors in all kinds of weather.

V. THE SHIP OF THE DESERT

There is one baby animal that rides when he goes bye-bye. He isn't carried on his mother's back, or in her breast pocket. He rides in a hammock on the back of a trained nurse. Something dreadful would happen to that nurse if he should stumble and drop the baby. Its mother follows close behind them all day, watching with her big brown eyes. The owner of the animals watches, too. That is a precious baby. If he lives to grow up he will be worth as much as a fine horse.

It is the baby camel that rides in this way. Although he is three feet high, and heavier than a bossy calf when he is born, he is so weak and wobbly on his legs that he can scarcely walk. Without his mother's milk he would die. The mother has to go with the caravan of hundreds of other camels. A caravan, or passenger and freight train of camels, travels fifty or more miles a day across the burning sand and rocky hills of the deserts of Sahara and Arabia. So the helpless baby camel is put into a hammock, and swung from one side of a big, two-humped freight camel. The nurse may carry half a ton of other things beside,—leather bags of water, bales of cloth and dates, jugs of oil and blocks of rock salt. All day long the nurse swings along at a rocking gait. The baby must feel much as a human baby feels when rocked in a cradle.

There is a curious reason why the baby isn't put on his mother's back. Camels are very stupid animals. If the mother could not see her baby, even if it was on her own back, she would be apt to think he had been left behind. Then she might turn and bolt for the last camping place. On the nurse-camel she can see him, and she follows contentedly.

A camel isn't really a wild animal, and he isn't really tame. He is too stupid to be either one or the other. For many hundreds of years the camel has been one of the most useful animals to men, because of his great strength, and his endurance of heat, thirst and hunger. But he has never learned to do more than a few simple things. He never seems to know or to care for his driver, or for a master who may have brought him up from a baby. He looks very wise and meek and good-tempered. But really, he has as little sense as a sheep, is as ill-tempered as a cross bull, and as stubborn as a



A FREIGHT TRAIN OF THE DESERT.
A caravan of camels carrying spices, silks, rugs and other merchandise.



A DESERT "LIMITED."
A swift camel speeding his master across the sands.



AN ARAB FAMILY WITH THEIR CAMELS RESTING NEAR AN ENCAMPMENT.

Photo, Brown Bros.

mule. He works, but not willingly, as a horse does. If he had as good a mind as the elephant, no man could make him work at all.

In the hot, dry desert regions the camel is the horse, the cow and the sheep of the Arabian herders and traders. He carries all the burdens, he furnishes flesh and milk for food, and hair for weaving cloth. To the children of America the camel is as strange and interesting as many of the fiercest wild animals. We know less about him than we do about bears. He tells you very little about himself, and he shows no curiosity about the crowds that visit his pen at the zoo. He gazes over people's heads in a dreamy way, just like that old stone sphynx head that stares across the desert in Egypt. One bright little boy once said: "A camel is a great, big, ugly puzzle." Let us see if we can work out a little of this living puzzle.

Don't go too near a camel's head. Sometimes, for no cause at all, he has a terrible fit of rage. Then he tries to bite and to kick the person nearest. The first thing you are sure to notice, and to laugh at, is the queer way in which he chews his food. His lower jaw swings from side to side like a hammock. His upper lip is cleft up the middle. It is what is called a hare-lip. The camel stretches and twists and feels its food with this thick, split lip as if it were two fingers. He doesn't seem to look at his food at all. So you are quite ready to believe he has never learned not to eat poisonous plants that grow on the desert. A herd of browsing camels has to be watched as close as a flock of silly sheep.

Everything about a camel is as queer as if you had dreamed him in a nightmare. His neck and legs look too long and sprawling for his body. His feet are split into two hooved toes almost up to the ankle. His head is too small, and is tipped up and poked out in a foolish sort of way. His long brown eyes fairly pop out of his head like agate marbles, from sockets too small for them. His nostrils are bias slits. He can open them wide or close them almost shut. His rough, red-brown hair looks as if it never had been combed. On his knobby knees and elbows and arched breast-bone he wears bare, leathery pads like a football player. Finally, his hump makes him look as if he had his back up against an unfriendly world.

One of the few things the camel has learned to do is to kneel when he is ordered to do so. At a word he drops. The pads protect his joints from the hard ground. He moans and groans as if in terrible pain. He knows some kind of a load is to be put on, and complains aloud. He doesn't wait to find out if the load is to be

heavy or light. He carries half a ton of goods for hundreds of miles across wide deserts, with ease. But he groans just as loud when he is asked to carry two little children about his track in the zoo. With more groans he heaves his big body up and starts to run, or rather to rock.

If you get sea-sick on a boat you would better not try to ride a camel. He lifts both feet on one side at the same time, tilting his body sideways. Then he lifts the two feet on the other side. So you roll over and back. Tossing and pitching, heaving and rolling you go, as if you were in a sail-boat on rough water. In a minute you are sick at the stomach. Very soon your back aches from the jolting, and you get a sharp pain at the waist line. Maybe you think this is why the camel is called "the ship of the desert." It isn't. It is because he carries people and goods across wide seas of sand.

Haven't you heard people say: "Handsome is as handsome does?" If you could see the camel at home where he "does handsome," you would forget what an ugly, ungainly beast he is. You would think how wonderfully he is made for the work he has to do. No other animal can live and carry great burdens in such a climate, on such scant supplies of food and water.

It is a wonderful thing to see a camel caravan start from a town on the edge of the desert. There are hundreds of animals in a great yard, tons of goods in bales, dozens of drivers and passengers, and a swarm of dogs. The owner of the caravan is a white-robed and turbaned Arab chief. He looks over every animal carefully. There are slenderly built racing dromedaries, or one-humped camels, with hair so fine that it is used for making artist's paint brushes and dress goods. And there are stout, short-legged, two-humped freight camels as shaggy as bears. Indeed, there are as many breeds of camels as there are of horses. The fleetest of foot can travel a hundred miles a day, the slowest only twenty-five.

The first thing the owner looks at is the hump. No camel is taken with the caravan unless its hump is big and solid. The hump is the camel's pantry shelf full of fat, to be drawn upon when food is scarce. Next, the feet are looked over to see that there are no stones between the toes, and no thorns or bruises in the soft foot-pads. Just before starting the animals are given all the water they can drink. A camel can drink enough water to last him three days. His second stomach is a honey-comb of little tanks for storing water.

The passengers, the chief, and the women and children of his family mount the dromedaries. Half a ton or more of goods, the leather water bottles, oil jugs, tents, sleeping rugs, bags of dates and beans to feed the animals, and the baby camels in their hammocks, are loaded on the stout, two-humped camels. The drivers and herders walk, and the dogs tail in at the end of a mile-long procession. At the front rides the chief and his sons, or helpers. They carry guns, for there are robber bands on the desert—regular train-robbers who “hold up” rich caravans, and steal goods and train also.

The start is made very early in the cool of the morning, while the stars are still shining. There is no roadway or trail. The sand shifts and drifts like loose snow before every wind, filling up tracks as fast as they are made. A camel caravan travels as does a ship at sea. It is guided by the sun and the stars, and by certain hills, rocky gullies and dreadful heaps of bleached bones.

In the hottest hours of the day there is a rest for men and animals; at night a long rest. Tents are put up and the animals are unloaded. A camp is set up under date palms beside a well. Every foot of hundreds of camels is examined. A torn or bruised pad is cleaned, dressed with healing salve and tied up in rags. The animals are hobbled by strapping one hind foot up to the knee, so they cannot stray.

For food, after a day's travel, a camel is given a small measure of hard, sugarless dates or dry beans. Besides, he crops leafless twigs, thistles and thorny shrubs. Camels will eat anything. They will chew their own leather bridles, or tent cloth. One witty writer has said that a camel can make a breakfast from a Sunday newspaper and an old umbrella. He can go without water for three days.

Day after day a camel caravan travels in this way, covering hundreds of miles, and touching at lonely green islands of oases. Sometimes a great wind storm sweeps over the desert, hiding the sun and filling the air with a blinding, stinging rain of sand. Down the animals drop, under their loads. They stretch their necks out straight, shut their eyes, close their nostrils to the narrowest slits, and lie still. The people turn their robes over their heads and huddle in the shelter of the loaded humps. Above the roar of the wind and the hissing and pelting of sand and pebbles, can be heard the low moaning and hard breathing of the camels. They seem to suffer. Yet, when the storm is over, they rise and rock on as before, across the burning waste.

Although the Bactrian or two-humped freight camel is a native of the high, cold plains of Central Asia and North China, he thrives and works just as well in the heat and drought of the desert. In his old home he is a draft animal, too. He carries burdens over snow-covered plains and even mountains. He sleeps out of doors on the snow in gales of icy wind. He eats, not only hard, bitter plants, but fish, bones and tough skins. He can go for a week without water, and when no other is to be found, can drink the salt, bitter waters of dead seas. On the desert he can carry heavier burdens and endure greater hardships than the one-humped dromedary, although he is burdened with an arctic coat of wool and hair. He is the ox of the earth's waste places, as the dromedary is the riding horse.

At night, when a caravan is in camp, the little children of the chief drink cups of the camel's thick, cheesy milk mixed with water. On the chief's table is camel flesh, as juicy and tender as beef. The herders wear robes and turbans of brown, camel's hair cloth. The master sleeps under a camel's hair tent. Without this ugly, stupid, useful beast, the hot deserts of the Old World would lie unpeopled and unknown. The camel knows nothing of his value and cares less. Like the desert itself, he submits to be used, but remains wild. Sullen and forbidding, he holds his master a stranger.

There is just one thing for which the camel has a softer feeling. The mother camel shows affection for her baby. After the day's march she has him all to herself. She nurses him, she nuzzles him with her sensitive hare-lip. He cuddles up to her for warmth. After the terrible heat of the day the night on the desert is often cold. But it is very still and clear. She can feast her eyes on her baby, for the dark, blue-velvet dome of the sky is hung all over with little golden lamps of stars.

VI. KANGAROO AND 'POSSUM, TOO

If you like to be surprised, all of a sudden, just stand by the kangaroo pen in a park zoo awhile. In fact, if you are lucky, you will be surprised twice.

You are sure to wonder, at first, why there is such a very high, strong fence of iron posts and netting around these queer-looking animals. No taller than kindergarten children, they sit upright as neatly as if on three-legged stools. You might say they *are* three-legged stools, for kangaroos rest on two hind legs and a long fat tail. From these broad bases their bodies taper up in the oddest way, to narrow, sloping shoulders and small, deer-like heads. Their full bright eyes glance about, their rabbit-like ears stand erect, listening. In front of the breast the short fore-paws are drooped, as if they are there less for use than for ornament.

Sometimes the kangaroo drops on all fours and eats like a rabbit, hopping about on his hind legs like a robin. But it seems to be easy for him to pick up a carrot, hold it between his paws and eat like a squirrel. The keeper knows what he is about when he scatters the food, putting some choice bits in the farthest corners of the pen. He does that so you can see the animals—*jump!*

There! You nearly jumped out of your skin, didn't you? That's surprise number one. When a kangaroo wants to go across his pen he doesn't waste time in hopping. He just stretches up on his hind legs and leaps. If a frog was as big he might jump farther than a kangaroo, but he couldn't jump as high. It really must have been the kangaroo, and not the cow, that jumped over the moon and made the little dog laugh.

No wonder the kangaroo can jump so far and so high. He has the biggest and strongest hind legs, for his size, of any animal in the world. His hind feet are so long it looks as if he were sitting on his hind elbows. At the end of the foot is the *biggest* big toe! It is in the middle of the foot, and has on it a long, sharp, wicked-looking, dagger-like claw. On one side of this big toe is a small one. On the other side a pair of helpless little twin toes dangle from the leg. The kangaroo's hind leg, foot and big toe are as wonderful, in their way, as the elephant's trunk.

A long, long time ago, when there were big, fur-covered elephants on the earth, there were also kangaroos as big as hippopotamuses,

with heads three feet long. Perhaps it was these huge jumping beasts that started the story of the giant, who wore seven league boots and could step over small mountains. Why, a kangaroo six feet high of today can leap over a horse and rider, and then get away by jumping as fast as the horse can run.

These queer animals live in only one place in the world—the big island continent of Australia, away around on the other side of the earth. Living on grass, small plants and the roots of herbs, they take the place of the deer and antelopes of other countries. Like other grass-eating animals they live in herds with leaders, and are naturally very timid and peaceable. There are a dozen varieties of kangaroos. The largest are as tall as a man, and weigh one hundred and fifty pounds. The smallest aren't as big as a rabbit. Some live on wide plains, some in the mountains and others climb trees and feed on the leaves. Like antelopes, they bound away on the slightest alarm. If overtaken and attacked, they will fight. The giant kangaroo can kill a man or a dog with one slash of the big-toe claw. A horse it will puzzle and frighten by jumping over it and back again. A small dog that annoys it, the animal is said to pick up in its forepaws, carry to a nearby pond or brook, and hold under the water until it is drowned.

Here is another odd thing. When feeding, two or three little ones follow each mother in the herd, hopping around her. On the slightest alarm the babies vanish! Not one is in sight as the herd goes bounding away. The little ones are not on their mama's backs, and there are no holes in the ground big enough for them to go into.

Watch the kangaroos feeding in the zoo, and maybe you can solve the puzzle of the disappearing babies. There doesn't seem to be a baby in the pen. Suddenly a little head, no bigger than a mouse's head, pops out of the fur on a mother's breast, like a jack-in-the-box, and pops back again. That is surprise number two. The mother kangaroo has a deep, flat, fur-lined pocket on her stomach. You never suspect such a thing because she can shut the top as tight as your mama can snap the clasp of her shopping bag. She can open it, too, for the little ones to jump in and out.

Kangaroo babies need that pouch. When they are born they are only an inch long—about as big as June bugs—and blind, naked and helpless. They cannot even suck their mother's milk, as kittens and puppies can. Their mouths fasten over the nipples inside the bag, and the mother *pumps* milk into them every so often. They

live in the bag for months, scarcely moving. The first time they come out they must climb up and tumble over the edge of the fur pocket, like little birds leaving the nest. For a long time afterwards they sleep and travel in the pouch. It is a sort of dining and sleeping car to them, and a nice place in which to play hide and seek.

There is only one other animal in the world that has a pouch just like the kangaroo's. Curiously enough this little cousin of the Australian kangaroo lives in the southern part of the United States, and doesn't look much more like him than a cow looks like a camel. He is about twenty inches long and has a body much like the body of the 'coon or little tree-bear. He lives in trees; too. Little boys—especially little colored boys—down South, often catch him when he is a baby and bring him up for a pet. He's the cunningest, brightest little fellow, with one trick that you like to copy.

Did you ever "play 'possum?" You shut your eyes and pretend you're asleep, for a joke. The opossum does this in earnest, to make an enemy think he is dead. He fools the dogs of hunters, sometimes, by rolling up into a limp ball and lying still. But a pair of bright eyes are watching out of the fur, and when the dogs are off guard, the 'possum unrolls and slips away.

The opossum doesn't jump like the kangaroo. All four of his legs are the same length, with five-clawed toes for climbing. He doesn't walk very well, and takes to a tree as quickly as possible. His dingy white or gray fur is tipped with brown all over, so it is not easy to see him in a tree. He has a long, scaly tail like a rat's, but he can use it as a monkey uses his tail for climbing and swinging. He has the sharp, pointed face of a big rat, the naked ears of a bat, the five-clawed feet of a little bear, and the pouch of the kangaroo. He makes his nest in the hollow of a tree like a bear, but he doesn't leave the babies at home. Mama 'possum carries them in her pouch when they are small. There are a baker's dozen of them—that's thirteen—and they are only half an inch long when they are born. She cares for them as the kangaroo mother cares for her babies.

When 'possum babies are big enough to come out of the bag—oh, about as big as mice—they like to ride on the roof of the car. There are so many of them that part of the family climbs on the father's back and part on the mother's. The babies sit in a row, clinging fast with their claws to the fur. The father turns his long tail over his back, clear to the head. The babies wrap the ends of their little tails around his tail, and away they all go for a stroll.

The 'possum is a night prowler. On still, bright, moonlight nights whole 'possum families are out in the fields, woods and swamps hunting for berries, nuts, grain and roots. They eat insects, field mice, little squirrels and birds' eggs, too. But, best of all, they love the sweet, frost-wrinkled fruit of the persimmon tree. This weakness for persimmons often gets the little family in trouble. Sometimes they are caught in a tree by hunters with dogs.

Usually they get away in safety. On an alarm—just a rustle in the grass, the distant bark of a dog, or the smell of a man or gunpowder, the babies pop into their mama's pocket. The whole family scampers back to the home tree, and slips, in two packages, into the grass-lined nest in the hollow trunk.

• Really, that nursery pouch idea is so clever, that one wonders why only the kangaroo and his little American cousin, the opossum, are provided with them.

VII. THE GRACEFUL CAMELOPARD

If anyone ever held his head high in this world it is Mr. Giraffe. If you could keep him for a pet he could easily poke his head in at a second-story window, and wake you up in the morning. He could stretch his tongue out, quite two feet, and lick your face, or twist it around a curl and pull your hair with it. And, if he would let you, you could climb out of the window onto his head, and toboggan-slide down his neck and back almost to the ground. You would have to put a feed box on the roof of the barn for him, and give him plenty of hay, corn, grass and carrots, or he would eat the tops of the shade trees. Maybe he would eat them anyhow, for he likes juicy green leaves that he pulls himself, better than anything else.

Guess what kind of an animal the giraffe is. Don't be ashamed if you can't guess. The Arabs on the desert, who have known him longest, gave it up long ago. They named him *Xi-raph'a*, which means graceful. A name that merely tells what a thing looks like is no name at all. Besides, the giraffe isn't a graceful animal. The Greeks, who were a very wise people, made another guess. They called him camelopard (ca-mel'o-pard) because, like the camel, he has a long neck, and his coat is spotted something like the leopard's. Really, the coloring and markings of the giraffe are more like those of the baby deer. The Greeks may never have seen the pretty spotted fawn of the northern forests, or they would have noticed that. The stretched-up neck, and small, arched, gazelle head of the giraffe are not at all like the thick, bent-down neck and tipped-up face of the camel. Let's look this queer animal all over and see what he is like.

He has the beautifully shaped, split hoofs and the slender legs of the antelopes, but the legs are so lengthened that his body appears to be lifted on stilts. His shoulders are so high that his fore-legs look longer than his hind legs, although they are the same length. He has a short brush mane, from between the ears to the shoulders, like the zebra, and the zebra, you know, is a small striped wild horse. He has the fly-whipper tail of the ox. Isn't that a mixture? But there's more to this living puzzle.

The giraffe's lustrous brown eyes are like those of the woodland deer, in beauty and gentleness, but they are set out from the head even more than the camel's eyes. Indeed, the giraffe can push

his eyes out sideways, as if they were on stalks, and look around behind him without moving his head. Wouldn't he make a grand school teacher? No other animal has eyes just like the giraffe's, and no other grazing animal has an eighteen-inch long, barbed rubbery tongue that he can stretch up another foot, twist around a bunch of leaves and pull them down. It is something like the tongue of the ant-eater or honey-bear. In just two things the giraffe is like the camel. He can close his nostrils against blowing sand, and he can go a long time without water. This is not because he has water pockets in his stomach. He simply seems to need much less water than other animals. Finally, the giraffe's long neck, high shoulders and short body, that form one curved slope from ears to tail, are quite unlike those of any other animal on earth. He is three times the height of a six-foot man, and towers five or six feet above the biggest African elephant.

As an animal, the giraffe is half-way between the ox and the deer. He is most nearly related to the antelopes, of which there are forty varieties in Africa, from the pretty, graceful gazelle to the gnu, or horned horse. But, unlike the ox, deer or antelope, the giraffe has neither horns nor antlers. The two, solid, bony growths on his head are covered with skin and hair, and are topped with tufts of bristles, comically like a pair of your papa's shaving brushes. The giraffe's leg bones are solid, too, while the large bones of all other grazing animals are hollow in the middle. Now, do you know what to call him? "Mr. Graceful Camelopard" is a misfit. He seems to have kept this name only because no other has been found that suits him any better.

Giraffes are very hard animals to find and to capture. Like the true antelopes they are less savage than they are timid. Very wild and shy, they trust to their heels for safety. They live in herds of from a dozen to fifty on the high dry plains of Central Africa, below the desert and east of the tropical forests. Their only enemies are lions, who lie in wait for them in the brush along river banks, and Arab hunters on horses. They are much brighter than camels. Two or three of their number always stand sentinel, while the others feed. This is very necessary, for the tall giraffes are shining marks in an open country. Their short-haired skins ripple and shine like satin with every movement, and in the sun the colors brighten to orange-brown and cream. In the shadow the colors fade and darken to sandy-fawn and seal brown,

A sentinel giraffe stands on the outpost of a herd, among the trunks of a clump of thorny mimosa trees, his head just peeping above the crown of leaves. Among the small trees his legs are not noticed. His body appears to be a part of the dancing leaf-shadows and sun-spots. His head, eighteen feet in the air, topping the low growth of the plains, with the open ears, keen nose and stalk eyes, makes a fine watch-tower. It isn't easy to take a herd of giraffes unaware. The only chance the lion has of catching one, is to spring on him while drinking. Even then a giraffe has been known to kick a lion to death. With five minutes' start the swiftest Arabian horse cannot overtake a giraffe.

If closely pursued, a giraffe can escape through a jungle of thorn bushes where men and horses cannot follow, and come through without a scratch. His skin looks to be thin and tender, but it is really so tough and so thick in places that soft lead bullets often flatten out on it. If cornered, the giraffe kicks like a mule. Dr. Livingston, the African explorer, says a giraffe's kick is as bad as a clap from the sail of a Dutch wind-mill. The animal fights with his head, too. Having no horns, tusks, or antlers, he does not lower his head and charge, like a bull elephant or buck deer. He gives a long, swinging blow sideways, using his head and neck as a sort of hammer, and striking with his powerful lower jaw and teeth.

As a rule the giraffe keeps out of trouble by running away from it. In running he has three gaits. He rocks like a camel with his neck stretched out; he trots like a horse with his head held high, and he gallops or bounds like the antelope, but more clumsily, his long neck plunging up and down with every bound. Because of his long stride he can get over the ground as fast as a horse, but he tires sooner.

Most giraffes in menageries and zoos are caught young. A mother has only one baby at a time, an ungainly spotted calf that is almost as helpless as a baby camel. When the herd is alarmed and starts to run a baby may be left behind and be captured. Full grown giraffes are sometimes caught with the cow-boy's lariat, but there are few rough riders who can throw a lariat loop twenty feet high and drop it over a giraffe's head. Great care must be taken to give the plunging, frightened animal plenty of rope, or he may give a sudden jerk and break his long neck.

In his new book on hunting in Africa, that all of you should read some day, Mr. Roosevelt says the giraffe doesn't always run when

men come near. He got very close to a cow giraffe that had her head in a tree taking a nap. So it seems, the giraffe, like the elephant, sometimes leans up against a tree to sleep. The animal looked at him sleepily a moment and closed her eyes again. As he came nearer she kicked at him. When the rest of the party came up and threw sticks and clods at her, she showed her teeth in an ugly snarl, like a cross dog. Finally she kicked out at them and then trotted away.

Of all the large animals in a menagerie or zoo, the giraffe worries his captors and keepers most. His neck is so long it is always in danger of being broken. He has to have an open sky-light in the roof of his cage to put his head and neck through. Sometimes, in turning around in his small cage, the neck is twisted or a bone snapped. In travelling on a railway, the roof window has to be kept shut, or the first low bridge would catch the head of the animal. He is not ill-tempered, as a rule, but having his eighteen feet of height jammed under a ten-foot roof makes him peevish. Sometimes he refuses to eat, and sometimes he turns vicious and attacks his keeper with his hammer of a head. So, although he looks so gentle, with his mild and beautiful eyes of a deer, you should never go very near a giraffe's cage.

But you should never miss a chance to see one of these strange and interesting animals. Like the bison, or what we call the American buffalo, the grizzly bear, the African elephant, the Bengal tiger, the kangaroo, and many other wild animals, the giraffe has been hunted so long that he is rapidly disappearing. A hundred years from now the children may be able to see only stuffed giraffes in museums of natural history. They will think how lucky the children of our day were to see these queer beasts alive.

VIII. MR. NOSE HORN AND MR. RIVER HORSE

"How do you say them? And which is which?"

That is what the very little boy asked about the rhinoceros and the hippopotamus when he came home from the London zoo. Their dreadful names made his head ache, and he couldn't tell them apart. He was sure children could have made up much better names for animals.

"Well, why is a dog a dog?"

"It isn't," said the very little boy; "it's a bow-wow." His papa laughed, for he was a very bright papa and saw the point. And then he told the very little boy that a great many things seemed to have been named, as a baby names a dog "bow-wow," by something about them that a child would notice first. Once upon a time, perhaps, a hunter in Africa or India, came upon two strange beasts. They both had enormous bodies on very short legs, and they both liked to wallow in the mud. When he went home he wanted to tell his friends about them so they would know the animals, too, if they ever saw them. One he called Mr. Nose Horn. That is, if he had been an Englishman, he would have said nose horn, but as he was a Greek, he said rhino-ceros, which means the same thing. The most striking things about the other animal was its huge horse-like face, and its habit of living most of the time and feeding in the water. So he called that animal hippo-pot-amus, two Greek words meaning river-horse.

No child could have made up simpler names than those. But, oh dear, when you come to study these queer animals it does seem that those wise old Greeks might have found better names. If they had thought of the shape of his body, his short legs, his rough, thick skin, of how he likes to wallow in a mud puddle and then go to sleep in the sun, of his four-hoofed toes, and of his sword tusks like those of wild boars in German forests, they would have called the hippopotamus the water-pig. And if those old Norsemen who used to roam over the northern seas in big row boats had seen the animal, these are the things they would have noticed: He can stay under water from five to eight minutes, he spouts when he comes up for air, his naked skin is oiled so he can slip through the water easily, and under that skin is a thick layer of solid fat. They would surely have thought the hippopotamus a land whale.

The hippopotamus has a body as long as the elephant's. It is from ten to fifteen feet around the middle, but the animal's thick legs are so short that he stands only five or six feet from the ground. Really his legs are better for swimming than for walking. He has the small, dull eyes of the pig sunk in folds of skin, small ears, a wrinkled, scowling forehead, a mouth two feet wide, and a bulging upper lip. He can use his sharp-edged tusks for rooting and for fighting, as the wild boar uses his tusks. He has a mustache of feeler hairs on his upper lip—like a cat? No, it is more like the bristles around the mouths of some whales—especially baby whales. But he doesn't breathe through holes in his head and spout water when he comes up to breathe, as the whale does. He has nostrils like other land animals. When he dives, he shuts his nose holes to keep out water, as the camel and giraffe shut theirs, to keep out sand.

Like other hoofed animals, the hippopotamus lives in herds and feeds on plants. From two to three dozen live together on the banks and in the beds of the warm rivers of Africa. They are not as bright as elephants, neither are they stupid. Not more than one or two of a herd are ever caught in the same kind of trap. Where hunters are about, the hippopotamus does not snort and blow when he comes up to breathe. Sometimes a herd leaves a place that is much hunted. They are rather timid and peaceable animals. When they hear a sound, or smell something they do not understand, they sink under water with only their noses above, and stand motionless, hidden among water plants. Maybe you have seen mud turtles do the same thing.

If attacked, a hippopotamus fights ferociously. A big bull hippopotamus will swim under a boat and tip it over, or bite a big piece out of the side, with his huge bark-cutting teeth. He chases the men in the water and gores them with his tusks. There are terrible "rogue," or tramp hippos, too, as there are among elephants.

A mother hippopotamus is the fiercest of all, if anything threatens her baby. She has only one at a time, and she makes it her chief business to look after him. He isn't born a swimmer, so for a long time he lives mostly on his mother's back. If caught young the baby hippopotamus is easily tamed, but he isn't bright enough to learn tricks. When his keeper comes to his cage he opens his two-foot wide mouth and begs for food in the most comical way. He asks for it much as a pig does. At home a herd of hippopotamuses at play shout with loud, harsh voices, but in a cage they creak and groan and squeal like very rusty hinges of a door.



RHINOCEROS, PHOTOGRAPHED IN HIS NATIVE WILDS.



HIPPOPOTAMUS, PHOTOGRAPHED FROM LIFE.

When a herd of hippopotamuses in the Nile River becomes tired of a diet of water plants, they climb up higher and steeper banks than you could climb, break into fields and eat wheat and sugar cane. Just think of having a drove of animals in your corn field as big as elephants with their legs sawed off, with stomachs that hold five bushels, and with the table manners of pigs! Then, sometimes, they like to plaster their red and brown and gray-splotched, hairless bodies with mud, and go to sleep in the sun just like pigs. The only thing that will keep them out of a field is a bon-fire. Practically all wild animals are afraid of fire. That is a good thing to remember if you ever go camping in the woods or mountains.

It is the rhinoceros, or nose horn, that ought to have *hippo* (horse) in his name. He is a very distant relation of the horse. He has teeth like a horse and a three-toed foot. The horse, today, has only one toe in a solid hoof, but in his leg are two splints where, ages and ages ago, there were two more toes that dwindled away and disappeared. No horse, wild or tame, or any of his near relatives, the zebras, wild ponies or donkeys, has a horn. So, perhaps, you will not be surprised to learn that a rhinoceros' horn isn't a horn at all, nor even a tusk. It is more like a corn.

This is the difference: A tusk is an overgrown tooth, a horn grows from the bones of the head, a finger nail is a sort of horny substance that grows from the flesh, a corn is a thickening of the skin. You get a corn on a toe where a shoe rubs or pinches. In rooting about for his food, or in fighting, the rhinoceros may have bumped his nose and kept on bumping it until a "corn" grew there. That "corn" is really a tuft of stiff bristles cemented together with a kind of horny glue. Around the base of it the thick hide grows in leathery folds, and the outer layer of the "corn" often peels back in shreds, like the rough bark fibre on a cocoanut shell. If you watch a rhinoceros in a cage, you may see his nose-horn move when he wrinkles his thick, over-hanging lip and forehead.

Except that he is a huge, nearly hairless beast who likes to wallow in the mud and water, the rhinoceros is not in the least like the hippopotamus. His legs, while thick, are longer, and lift his body higher from the ground. His head tapers to a pointed muzzle, and he has the upright, nervous ears of the horse. A regular wild horse in armor he is, for his thick, leathery skin is laid on him in folds that overlap at the natural joints of his body. Having such a weapon right between and below his eyes, where it is always in

sight, the rhinoceros doesn't miss many chances of using his nose-horn. He doesn't try to avoid trouble as the more timid hippopotamus does.

The rhinoceros is a grazing animal, too, but does not find his food in the water. He feeds by night on wooded hillsides, in the brush or on swamps, and uses his nose-horn to pry up roots and his horse teeth to bite off grass. During the heat of the day he often takes a cool bath and rolls in the mud. Very likely he goes into the water many times for the same reason as the elephant. He is tormented by flies and stinging insects. Like the elephant he, too, has a feathered friend. Isn't it odd that the rhinoceros bird should also have a nose-horn? He is Mr. Horn Bill. This bird travels around on the animal's back and picks the insects out of the folds of skin. He has that choice feeding ground all to himself, for the rhinoceros baby doesn't ride on its mama's back. Papa pushes the baby along in front of him with his horn, as if he were in a baby cab, on wheels.

The rhinoceros can hear and smell well, but, like the hippopotamus, his small eyes are very dim. The bird on his back often gives him the first warning of danger by uttering a loud cry. At that the animal plunges into the brush or makes for the nearest water. He can out-run a horse, but he doesn't run away, as a rule. He merely chooses his own place to fight. He runs into a pool or river, rolls over in the water, and heaves up, his huge, black, armored sides dripping.

Ten feet long and seven high, with a dagger-like curved weapon three or four feet long on his nose, the bull rhinoceros is a monster. He tosses his huge, horned nose, sniffs and snorts and lowers his head for the charge like a wild boar. Knowing that he sees badly and charges straight, a skilled horseman can dodge him. A lion leaps over him, tucks his tail between his legs and sneaks away. An elephant that stands twice as high, often weighs but very little more, and is no match at all for this big brute. The rhinoceros can run his nose under the elephant's body and kill him with one stroke of his dagger horn.

Here is something about the rhinoceros that is very interesting. Thousands and thousands of years ago enormous hairy rhinoceroses with two nose-horns and shaggy manes, roamed over all the colder parts of Europe and America with the giant hairy elephant. The bones of a great many of them have been dug up on the banks of the Upper Missouri River. Just think! Enormous two-horned and

two-tusked woolly beasts, bigger and fiercer than any elephants and rhinoceroses of today, may have uprooted trees and cropped wild grass on the very pasture where your pretty Jersey cow eats clover.

So there's another thing to help you remember Mr. Nose Horn. He was once an American, and might even feel at home here in some places, the hot swamps of Florida, for instance. Mr. River Horse, who is really a water-pig, is a stranger.

Now do you think you will ever forget "how to say their names, and which is which?"

IX. WILD ANIMALS NEAR HOME

Do you live on a farm? Or in a small town with woods and fields around it? There is a creek, perhaps, a swamp, hillside pastures, stone or rail fences bordered by briars. Then you have animal neighbors as wild and 'shy as any you will see when the menagerie comes to town. Take a long tramp over the country after a light snowfall. Don't take a dog with you. Take an opera glass, a microscope and a camera. Walk in the face of the wind, or all the little wild creatures will get early news of you and vanish.

Watch for foot-prints—trails of tiny tracks in the snow. Those are calling cards. Some nature-lovers can read every kind of track as easily as you read print. They can tell where a rabbit has gone across country by long jumps, and sat on his haunches in places to "stop, look, listen!" They can tell where squirrels have played tag around a tree; where field mice have chased each other around a straw stack; where muskrats have come up the bank of a frozen pond; where a chipmunk has sunned himself on an old stump lookout.

There are very few places in America where some of these rodents—little gnawing animals—are not to be found. But city children often know the common gray squirrel and the little brown chipmunk, better than country children do. That is a pity, for where they are not hunted all our native squirrels become very tame.

In a city park if you sit on one bench day after day and scatter peanuts or popcorn near you, the squirrels will learn to come to be fed. They leap on the bench, by and by, eat from your hand and go into coat pockets for nuts. Be patient at first, and keep wide awake, or you will miss seeing little switch-tail when he slips, a gray shadow, down a tree. Flash he comes, stops, "freezes" on his haunches, bright eyes watching, ears and plume up. Shelled corn scattered about a farm or country school yard will coax him out of the woods. Don't try to catch him or he will never come back.

What a pretty little fellow! All silver-gray, brownish-gray or even black, he is, for squirrels of the same family vary in color, just as foxes do. A little ten-inch furry bundle of fun, with a ten-inch banner of a tail! He plays tag, leap-frog, runs races on walls, rolls up and coasts down hill. He is just as curious about you as you are about him. He is very gossipy, chattering all day, but he

attends to business, too. If he is hungry, he will sit up and show you how to crack and eat a nut. Then he will carry away what you give him, one nut at a time, and bury each, lightly, in a separate place. He will come back for them, by and by, and carry them into his high pantry in a tree.

On a snowy morning his foot-prints will guide you to his elevator door, the foot of a tree. Sometimes he uses a hole for a den, but often a crow's nest hammock, roofed over with leaves and bark. He cares neither for cold nor wind. His nest blown down by a gale, he catches on a limb like an acrobat, or drops on his feet like a cat. After eating he washes his face like a cat.

For the underground burrows of the chipmunks, look in the deepest woods, around old stumps, logs and boulders. Look sharp. Tail and all the chipmunk is less than a foot long, and he is just the color of rotten wood. Even the black and white stripes on his back are mere lights and shadows. A sunny, woodsy streak, he flashes across the open, stops stock still, upright, alert, and is gone. You are not sure you saw him at all. Perhaps you heard his gleeful "chip, chip, chip!" It is a challenge. He would just as soon lead you a merry chase as not. Little soldier, every log is a breastwork, every stump a sentry box, every screen of undergrowth a retreat. And for all he burrows, he is not a true ground squirrel. He can climb, and his habits are those of the tree squirrels.

With a last saucy "chip!" he is gone. Find his house-door, if you can. He hides the little round hole cleverly among drifted leaves, shaded by ferns and moss. You will find his snug den below frost-line, leaf-bedded and stored with acorns, nuts, and red winter berries. But you will not find the owner at home. He has another house or two just like it, and his bright eyes may be watching you a few yards away.

No country in the Old World has so many true ground squirrels as we have. Prairie dogs, gophers and woodchucks are ground squirrels. The gopher is the ill-tempered, rat-like hermit of the garden. You may be sure he is under a flower or vegetable bed, biting off roots, if plant tops suddenly wither. But be careful in digging him out. He cannot be tamed, and he bites with his chisel teeth. The prairie dog is found only on the wide plains of the West. To try to dig a village of these amusing little yappers out is like starting to dig a well. In the park zoo the prairie dog village is in a deep cement-lined pit filled with earth, so these clever little animals cannot tunnel and spread over the park.

You can dig the woodchuck, or ground-hog, out. He is the fat, sleepy-head bear squirrel. Don't look for him in the woods. Keep your eyes open when crossing a hill-side clover field, or in going down a steep creek bank. If you see a hole big enough to thrust your arm in, probe it with a stick. If the hole slants upwards, Mr. Woodchuck is there. In the winter you can dig him out and roll him on the snow, like a flabby muff of coarse, gray-brown hair. He is so fast asleep that if you take him into a warm house he will open his eyes, yawn, crawl under a bed or bureau, and go to sleep again. Some people say he wakes up on the second of February. If the sun is shining, and he sees his shadow, he knows there will be six weeks more of winter, so he goes to sleep again. With his clumsy body, flat head, beady eyes, and small ears and tail, he doesn't look in the least like a squirrel. But he sits upright to eat, and to look about. He never goes far from his hole, for he cannot run well. When alarmed, he jumps to shelter like a rabbit.

Molly Cottontail pricks up her nervous ears at that. "Not run well! Just watch me for three seconds!" she says. Look out for bunny. She is the color of dead grass, weeds and snow. She may be at your feet, or in that weedy fence corner. She smells you, hears you, sees you. She doesn't know yet, whether to sit still or to run. Boys can't smell rabbits, but dogs can. "Zip!" there she goes, a flying brown shadow, the bit of white under her tail, a flag of truce that no one regards. Poor Molly Cottontail! A timid, helpless creature, her only safety is in her legs. She cannot climb a tree, dig a den, or bite. She cannot crack nuts nor store food. She can run fast but not far. Her home is wherever she sleeps, out in the open, ears erect, eyes half-closed, nose wide and quivering. She is lucky if she gets forty winks at a time. If no dogs are about, she may creep under a barn, or in a wood pile, in cold weather. She distrusts a hole, because foxes, owls and other enemies live in holes.

The one clever thing she can do is to cut tunnel roads in undergrowth. Bunny slips and winds through these six-inch mazes of runways she has patiently cut with her teeth. There she puzzles and tires out dogs and foxes by crossing the scent, and so gets away. A sociable little creature, Molly lives a fugitive life and all alone, for safety. On some brambly hill-side, you may come upon the shallow nest she has scooped out and lined with white fur from her own breast. Do not frighten her. There she brings up her brood of six or eight babies, in fear of their lives and her own.



OPOSSUM



PRAIRIE DOG



MUSKRAT



GOPHER



WEASEL



WOODCHUCK OR GROUND HOG



MOLE



SKUNK CROSSING A STREAM



CHIPMUNK



RACCOON



SQUIRREL



MINK



RED FOX



COYOTE

When crossing a field in winter, stop and listen at hay and straw stacks, and shocks of corn fodder. On the stillest, frosty day you may hear a crisp rustling within. Look all around for the tiny, bird-like tracks of field mice. Most field mice make beds in the ground and sleep all winter, but others stay awake. They are the bed-makers of our wild life. They can make a warm bed of anything—leaves, grass, corn-silks, feathers. Up in the woods you can find the tiny trails of the fawn and white deer-mice, and find their feather-lined nests in rotten stumps. You will know them by their big ears and bright black pop-eyes. Certain mice tunnel around pits of potatoes, beets and cabbage. They store clover and other roots in earth pockets. In countless hidden places out of doors these busy little gnawers have nests of babies no bigger than thimbles.

The mole you can always find by the long ridge of cracked earth that zig-zags across fields—the roof of his tunnel. It is lively work to dig out a mole, for he may be at either end, or anywhere along the route, or in a side chamber. If frightened by the noise you make, he will go deeper and bore a yard in ten minutes.

In your hand he lies helpless, a flat ball of fine, velvety, mouse-colored fur, six inches long. He has no neck or ears, dim pin-points of eyes, and a naked, pink tail that looks like a short, fat earthworm. Put the sprawly, wriggly creature on the ground. He scrambles about frantically until he finds a soft spot. Then he begins to bore with his bony gimlet of a nose. With his spade-like fore feet he digs and pries the earth back. In less than one minute the animal has disappeared. Do not kill moles. They are insect eaters. Mice, ground squirrels and rabbits are root eaters. The mole goes through the earth and around roots, eating slugs and beetles.

In the story of "Big Brother Bear," and in the main part of this book you can read about the raccoon, or little tree-bear. And in "Kangaroo and 'Possum, Too," you can read about the opossum who has a fur pocket on her stomach to carry her babies in. These animals are found only in the South, as the prairie dog is found in the West. Every part of our country has some special small, wild animal—mink, weasel, badger, fox, skunk—whose haunts and habits are interesting. There is just one more that is found all over the United States, wherever there are creeks, ponds and swamps. This is the muskrat.

You can scarcely go skating on a frozen pond in the winter without finding a dome-shaped, mud and grass house, or a little

village of a dozen homes frozen in the ice and covered with snow. Mr. Sharp, a nature writer, says that you can skate all around them and sit on one to strap your skates, without bothering the furry bunch of sleepers inside. But push a stick carefully through the thick wall and you can hear a soft skurrying inside, then a "plunk, plunk, plunk!" as one after the other plunges into the water, through a doorway below the ice.

The muskrat doesn't mind. You couldn't wet his sleek, brown fur coat any more than you could wet a duck's feathers. He only sleeps in the daytime, in winter. Each stout dome has a single room. It is a sort of club house, or European hotel, where a number sleep in one bed, snuggled up to keep each other warm. At night they all tumble out into the icy water and hunt for food. They dive for fresh water mussels, and bite off tender white calamus blades. You know how good calamus is. They bring their food up through a hole and wash it, just as the 'coons or washing-bears do. After this feast of a sort of oysters on the half-shell and celery, they often go up into orchards for frozen apples—fruit ice. A dainty feeder is the muskrat.

The muskrat builds his house only for a winter sleeping place. In the summer he burrows in the bank or builds under bushes on the swamp. Mr. Burroughs says he is a fine weather prophet. If he begins to build by October—and he works only at night—you may be sure there is to be a cold winter. Or, if he builds very high and strong, his house solidly plastered to logs, stumps or tussocks of grass, look out for high water.

A dark lantern, with which you can throw a light over a pond, will give you glimpses of muskrat families feeding. Only a foot long, their fur is so thick, rich and glossy a brown that it is sold as river mink. Muskrats sit up to eat, something like squirrels, or rather like kangaroos, using their six-inch, flat, scaly tails for third legs. They use those tails for rudders in swimming, too, and with them they slap the water to warn others of danger. Perhaps, who knows, they use them as beavers use their tails, for trowels in plastering their houses with mud. For his size the muskrat is just as bright and clever as his big cousin, the beaver.

Even where they are too quick, and you fail to see them, you can tell where muskrats have been by a faint musky odor, as of a flower perfume on the frosty, moonlit air of a lonely marsh.

TYPICAL INDUSTRIES

EDITORS' NOTE TO MOTHER AND TEACHER

And children coming home from school
Look in at the open door;
They love to see the flaming forge,
And hear the bellows roar.

In writing that verse into *The Village Blacksmith*, Longfellow expressed a profound truth. Children have a natural interest in the work of the grown-up world. They love to watch the blacksmith, the carpenter, the mason, the miller, the shoemaker. Boys, too young to work, follow the threshing machine from farm to farm. Village boys hang about the railway station to watch the locomotive and the grain elevator. They want to know how things are made, and what makes the wheels go 'round.

The experience of industry a boy can get in this way is considerable. Unfortunately, the workman doesn't want a boy around. He is in the way; often he is in danger. In any case, the industries near him are limited in kind, number and function. A flour mill is only one step in a long series of connected processes that produce the world's bread. Understanding of how any one man's work is bound to all the other work of the world, broadens the mind of the child wonderfully, and teaches him respect for every sort of labor.

To supply the lack of real objects of study, the following sketches were written. Children are nearest, in experience and interests, to primitive peoples. It is a curious thing that the very earliest occupations of supplying food, clothing, shelter and tools are still the fundamental industries, and must always remain so. Moreover, they are the most highly developed, and employ the large majority of workers everywhere. These facts have governed our choice of wheat and rice, iron, cotton, wood-working, pottery and glass-making as typical industries. The making of watches was added to satisfy the child's natural curiosity about machinery; and matches to set him thinking of the wonders of cheap, everyday necessities. We have connected all these varied industries with the school studies of geography, history, mathematics, drawing, chemistry, physics and astronomy, showing their practical use. A voyage into the *World-at-Work* opens a new and fascinating wonderland to the children.

WHEAT

I. BIG BUSINESSES FROM LITTLE SEEDS

What did you have for breakfast?

Bread and butter, toast, muffins, batter cakes. You had other things, too, but all of you had some kind of bread made of wheat flour. For dinner you will have crackers with your soup, and perhaps pie or cake. Those will be made of wheat flour, too. We use more wheat in America than any other kind of food. Everyone who lives here eats a barrel of flour every year. That is about ninety million barrels. It takes nearly five bushels of wheat to make a barrel of white flour. Four hundred and fifty million bushels of wheat! Yes, indeed! But we really grow about seven hundred million bushels. We have a great deal of wheat and flour to sell to countries across the ocean, where they cannot grow enough to feed all the people. Wheat is the bread of all white people. They use corn and rye and oats, too, but more wheat than all the others put together. The Chinese and Japanese and Filipinos and many other peoples eat more rice. But they are beginning to buy our white flour, too.

Where does all this wheat come from? Just farms. Little farms and big farms, in a great many of our states, grow wheat. These wheat fields cover fifty million acres of our land. Some wheat fields are so big that a hundred men go into them at once. They ride on sulky plows drawn by horses, or they use steam plows. Then they go over the fields again with steel-toothed harrows to break up the clods. They follow the harrows with drill seeders that drop the seed through pipes in rows. Behind each pipe is a little plow like a garden trowel, that covers the seed. In some parts of our country wheat is planted in the spring. In others, where winter is less severe, it is planted in the fall.

Did you ever get your name in a newspaper? You were proud to see your name in print. Our president gets his name in the paper very often. But no one, not even kings and queens, gets a column or so every day in all the big city papers in many countries and in many languages. Wheat does. Wheat is the bread of many people.

STORY OF WHEAT



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THE OLD WAY.

Plowing with oxen and a wooden plow. This is a recent photograph, showing that in Egypt they still plow just as they did thousands of years ago.



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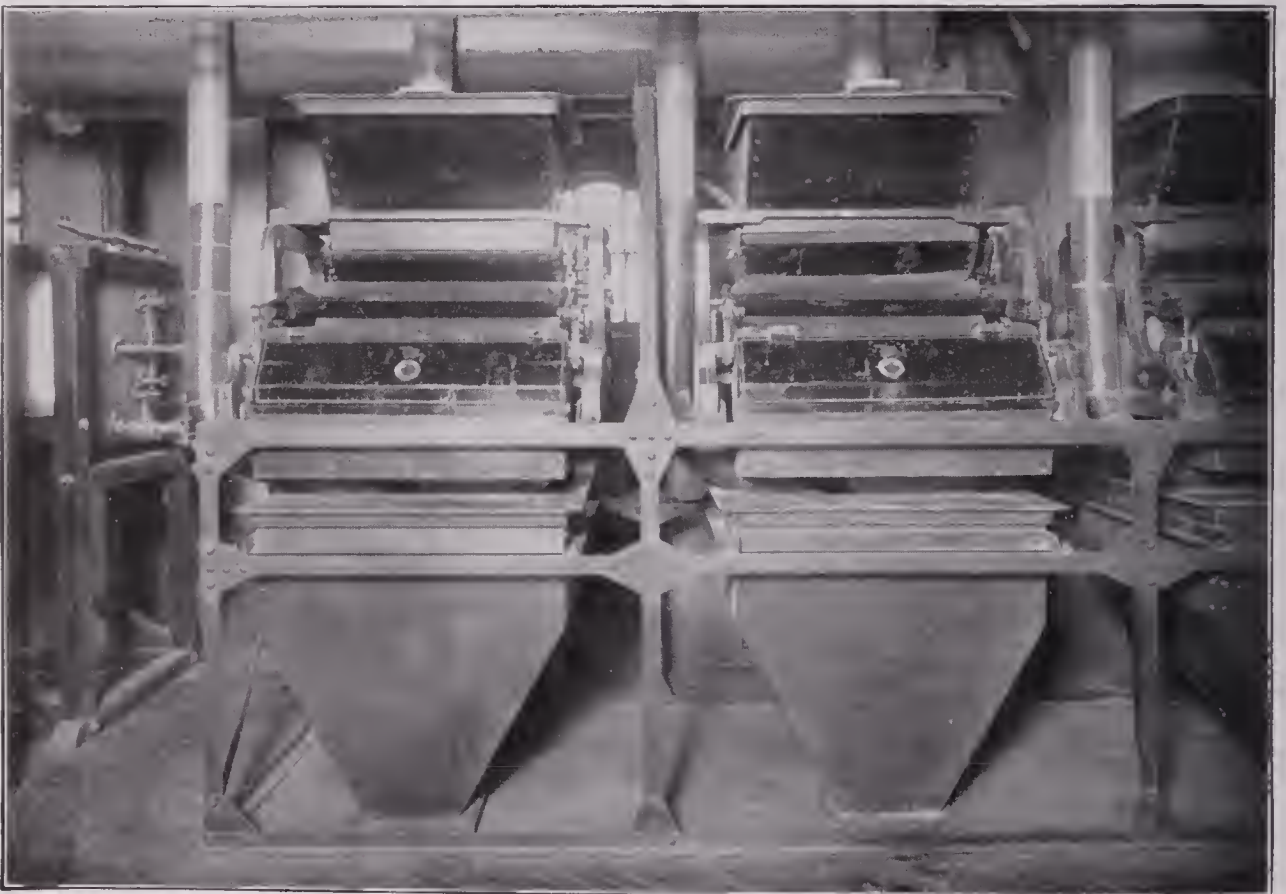
THE NEW WAY.

A modern gang plow drawn by a traction engine and turning eight furrows at a time.



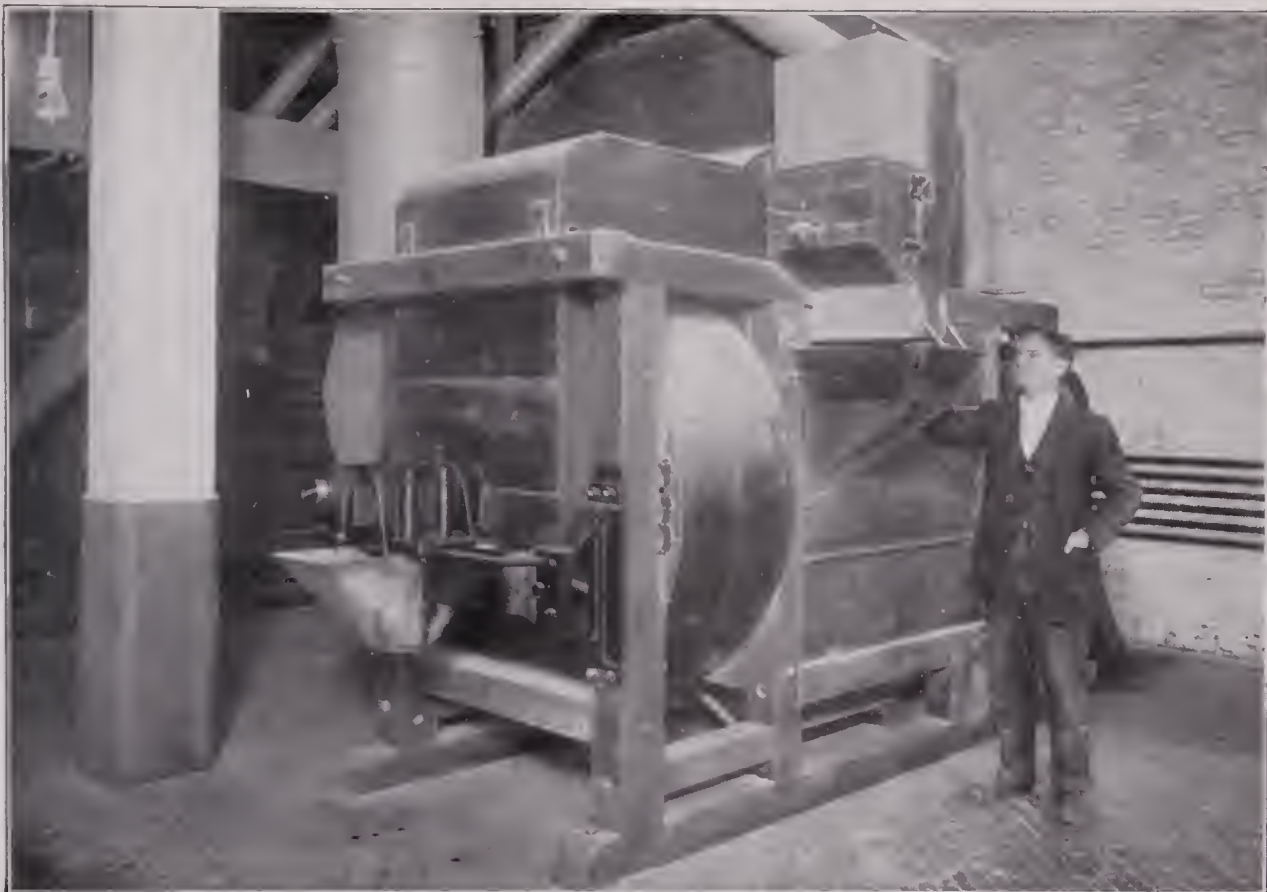
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When the wheat is marketed it is stored in immense elevators, some of them holding two or three million bushels. The elevators are provided with long spouts which can be lowered into the hold of a vessel, where buckets carried on a link chain catch up the grain and carry it up into the elevator. A cargo of 200,000 bushels can thus be unloaded in two hours. Spouts on the other side of the elevator can reload the wheat into cars if desired, filling a car in from five to ten minutes.



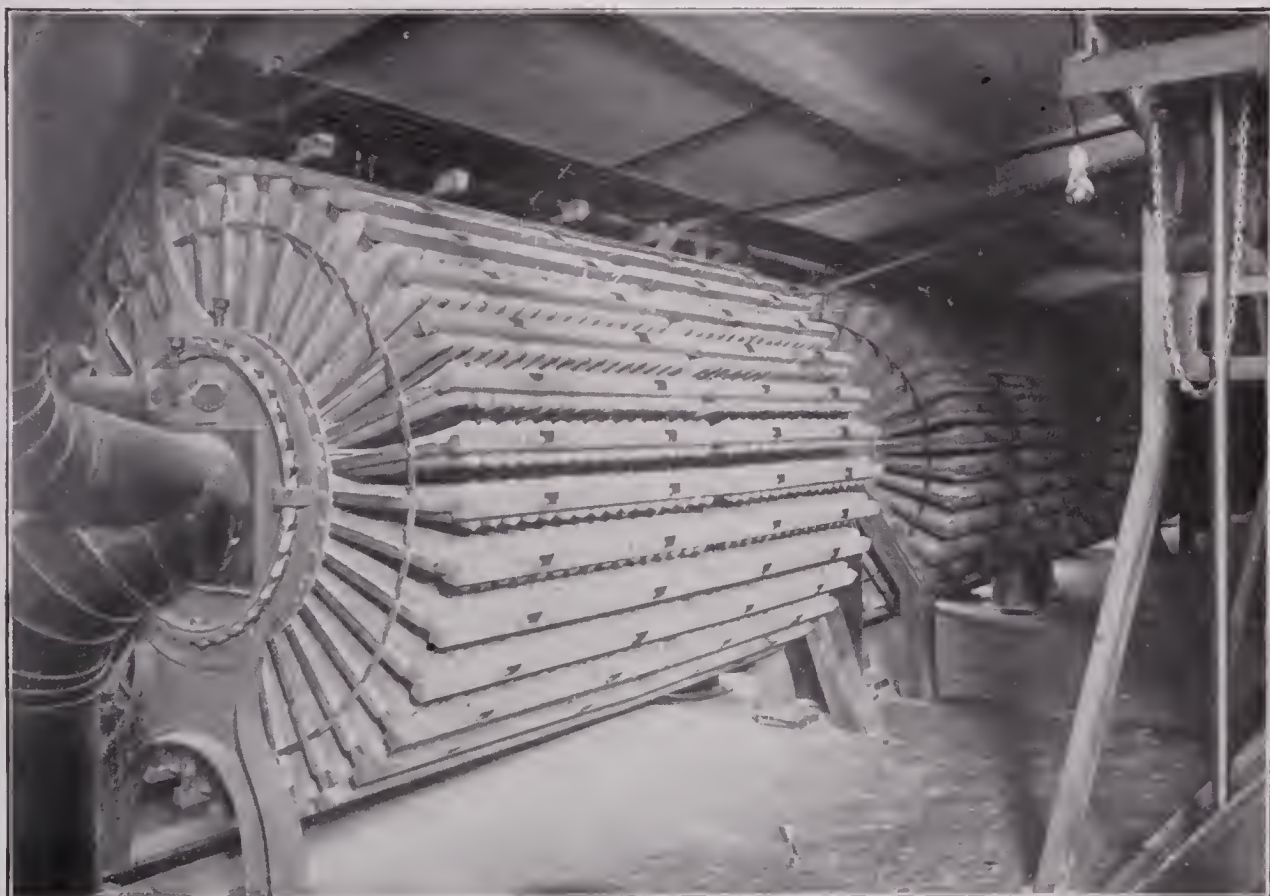
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Often next to an elevator is a great flouring mill. The wheat in the elevator first passes through a warehouse separator which frees the wheat from any impurities, such as stones, straw, grains of corn, oats or barley. The wheat is then weighed by automatic scales here shown, which weigh a given quantity of wheat at a time. The weighing of each quantity requires about one minute. The scales register the number of bushels. From the scales the wheat passes to the bins.



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Wheat after it is drawn from the bins, is conducted through the scouring machine represented in this picture. Here it is thoroughly cleaned from such impurities as may stick to the kernels of wheat. When thus thoroughly cleaned and polished, the wheat is steamed and sent through the grinding rolls.



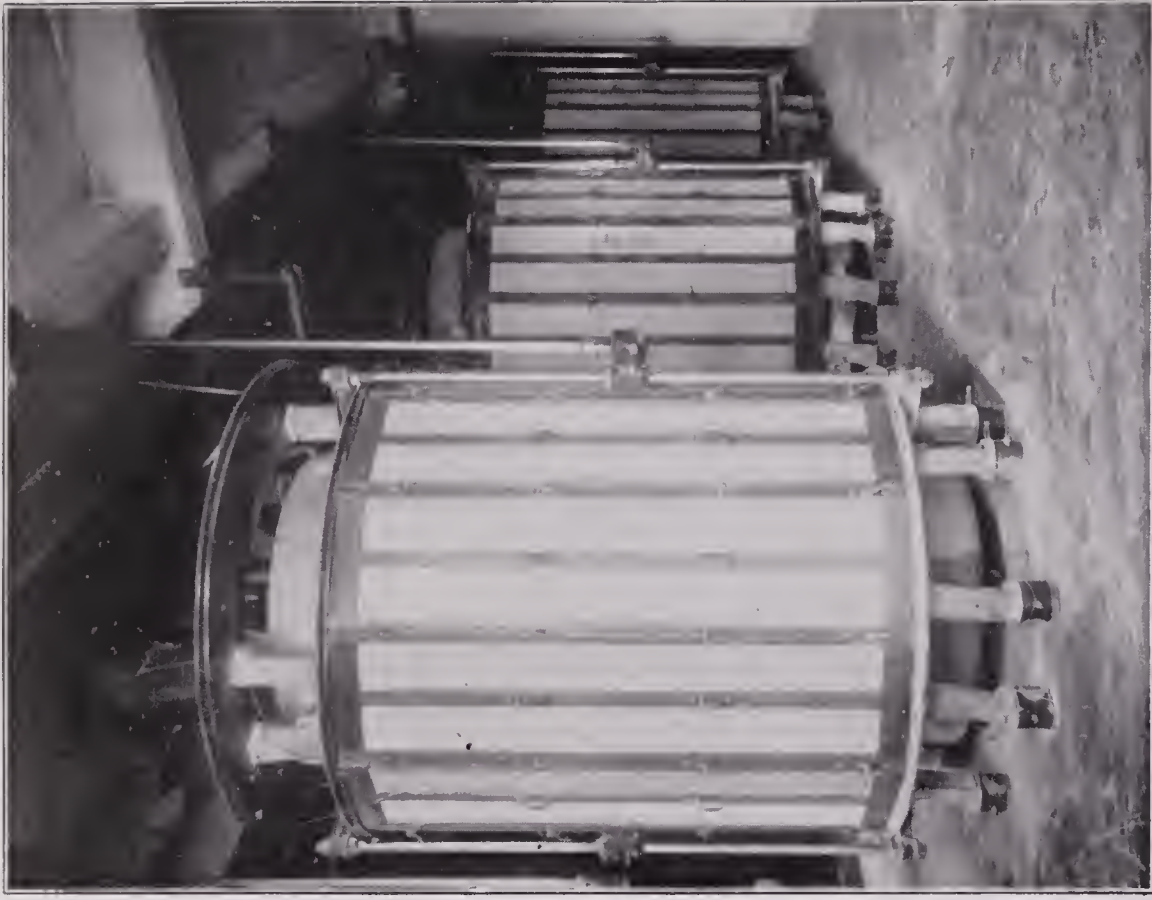
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These striking looking machines are called dust collectors. The dust from the wheat and also the fine flour dust which accumulates are drawn off by a process of suction pipes which convey the dust to these machines. From them it is sucked away to the refuse cans.



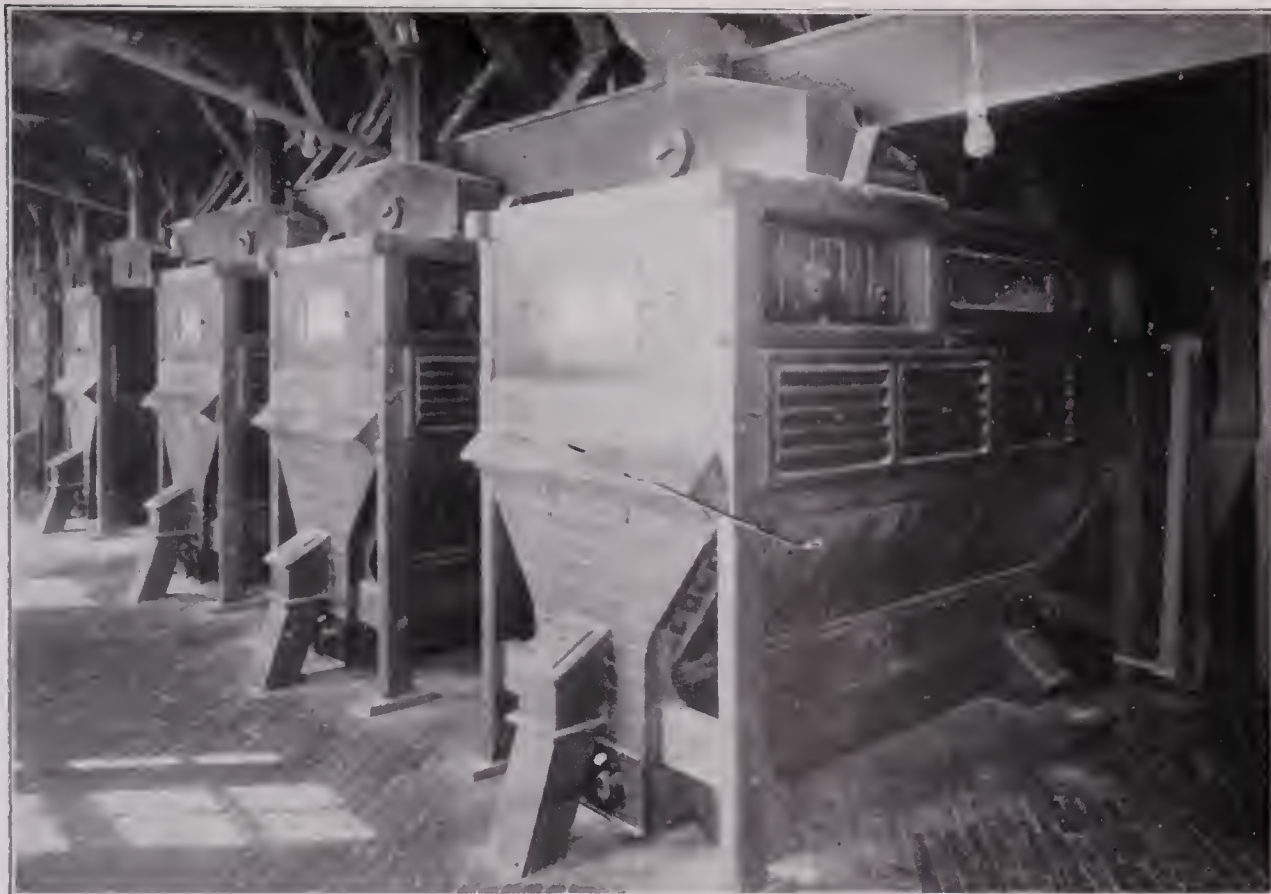
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As the change from the cradle to the modern harvester revolutionized the harvesting of grain, so the introduction of rollers in place of mill-stones revolutionized the whole system of flouring. Stone grist-mills which were found in every town have almost wholly disappeared and the flour of the world is now produced in the great merchant mills. After scouring, the wheat is heated by steaming and passes through the rollers for grinding. A roller is a machine fitted with a pair of rolls made of chilled iron. These are grooved and the grain passing between the rolls, as they revolve, is broken and cut, first into coarse parts and then into finer particles, as it passes through four or five of these graduated machines.



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After grinding, the product is put into the bolters, an apparatus of gigantic proportions, whirling at a high rate of speed. Here the mass is shaken through bolting silk, from the coarsest to the finest, until only the flour remains.



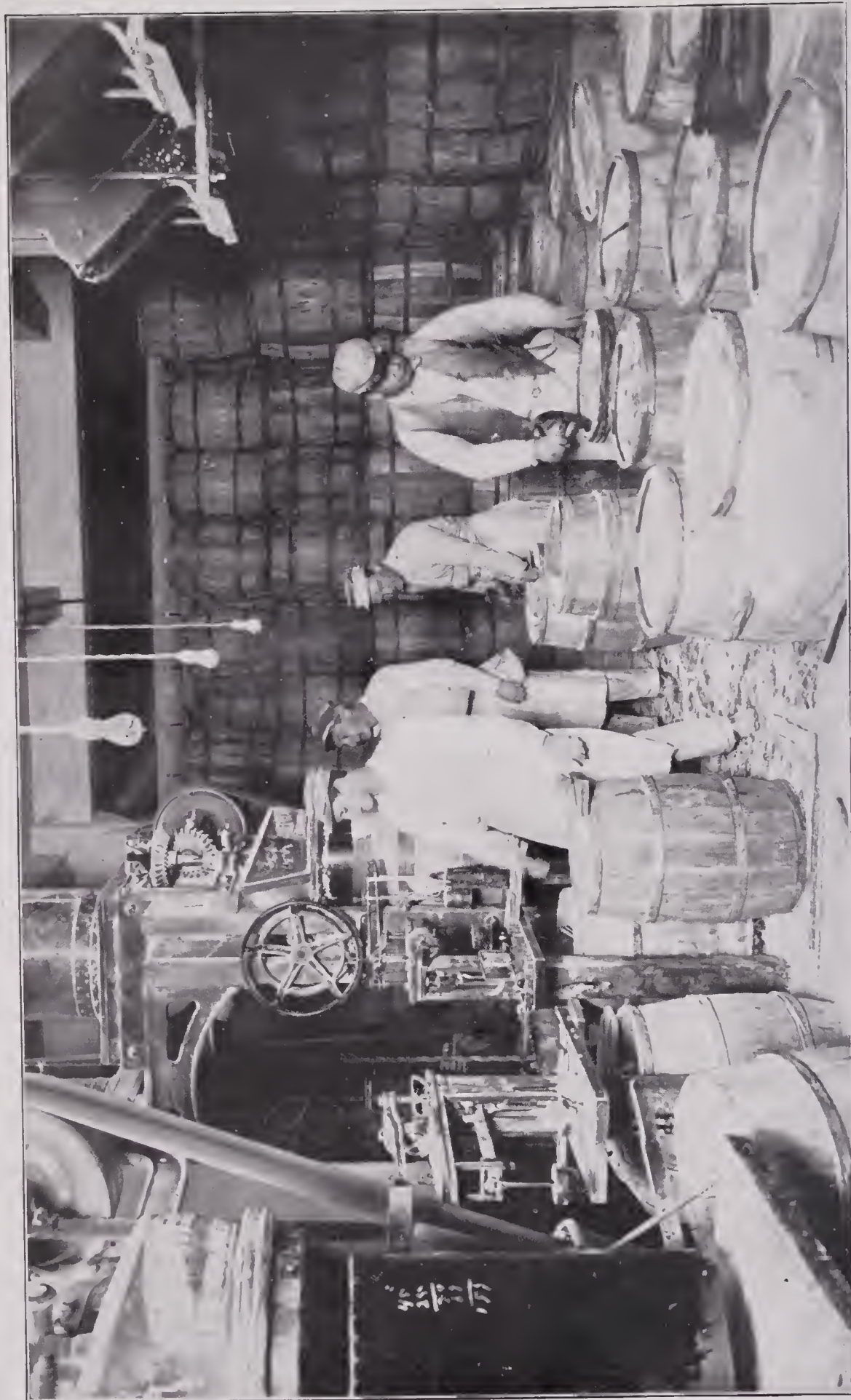
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From the bolters the flour passes through a purifier. This machine is one of the most important of modern improvements in making flour. The flour is fed on a sieve set at a slight angle. A current of air is drawn upward through this sieve, blowing the stock upwards. This allows the heavier and better material to remain below, while the lighter and impure particles are separated and carried away.



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From the purifier the stock goes to the smooth rollers where it is pressed into flour. From the smooth rolls it passes to the dresser, a centrifugal machine which consists of a cylinder with an internal shaft, on which are keyed iron beaters which fling the material against the silk clothing of the cylinder. This is the final stage through which the flour is carried, and from here the finished product is conducted to the packing room.



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The flour is conveyed through spouts to the packing room, where it is packed in bags and barrels by a machine which weighs the proper amount and then stops by automatic action. The bags and barrels are then closed and marked for shipment. These modern mills are conducted automatically. From the time the wheat enters the warehouse until it is sacked in the shape of finished flour, it is touched by no human hand.

They are all anxious to know if bread is going to be cheap or dear. How much wheat is being planted? the world asks. But that doesn't answer the question about bread, for many things may happen to wheat after it is in the ground.

How is the soil everywhere wheat grows? Is there enough rain? Or too much? Owners of railroads and ships are interested in the size of the next wheat crop, for they will have to carry the grain and flour across land and water. Owners of flour mills want to know how much they will have to grind, and what they will have to pay for it. Men who buy and sell wheat, owners of grain elevators who store wheat, bakers of bread and makers of breakfast foods and macaroni are interested, too. Village storekeepers are anxious to know if the farmers will have little money or a great deal to spend. Factories want to know how much goods to make, railroads how many grain cars they will need. Every farmer who grows wheat wants to know what other farmers are doing, and what his wheat will be worth. Wheat is so important that our government makes a crop report once a month. Corn and oats and other foods are put in, too, but wheat comes first.

From the fuss that is made about it, you would think the farmers were tucking precious babies into cradles when they put the little brown wheat seeds into the ground. Well, they are. The world wants to know every day how those seed babies are getting along. Wheat has as many troubles as human babies. In dry summers little chinch bugs feed on them. In cool, moist summers the tiny Hessian fly, only one-sixth of an inch long, lays eggs that hatch into little worms on them. Then there is the mildew and rust. In the spring, wheat needs rain or melting snow. At harvest time warm sunshine to dry the ripe grain.

Harvest time is exciting. Where do you think the excitement begins? Not in the wheat field where the grain is turning from green to gold, but in big city banks that may be a thousand miles away. The farmers must have a lot of money to pay men and machines to save the wheat. They go to the banks in the small towns where they trade, to borrow money. In a few weeks, when the wheat is sold, they can pay the money back. The little banks have to borrow money of the big city banks.

Come and see a big wheat farm in harvest time. It is a golden fleece as far as you can see. First come the reapers to shear the fleece. In the old days, and in many backward countries today,

men cut wheat with scythes by hand. An American fastened a number of scythes or blades to a shaft and made a reaping machine that could cut as much wheat as many men. (See McCORMICK, page 1133.) The reaper not only cuts the wheat but gathers it in bundles with the heads all one way, and ties the bundles. It is really a reaper and binder. Men gather the bundles behind the reaper and stack them in shocks for the sun to dry the grain.

A few weeks later a big red threshing machine goes from farm to farm. It is run by steam, like a fire engine, and it makes the same chug-chugging noise. It stands in the middle of the field. One man runs the engine. Others bring the bundles, feed them to the thresher. The heads are torn off, and the straw showered out behind. The grains are shelled from the husk, the chaff blown out in a golden rain, and the wheat grains dropped below. In one day a big thresher can clean two thousand bushels of wheat. It takes a great many men to feed its clattering iron jaws, to pitch the straw back so the thresher will not be buried, and to catch the grain in bags or wagon beds. And you ought to see the harvesters eat! Farmer's wives and daughters have to work a week to get food enough for one day. A combined reaping and threshing machine is now made which cuts the wheat, threshes it and delivers the cleaned grain in sacks.

Then what happens? The wheat cannot lie on the ground, and no farmer can afford to have a great storage house that he would use only a few weeks. His nearest town on a railroad has one for all the farmers who trade in that town. This storage house is called a grain elevator. It stands beside the railway. It looks like a very tall barn with only a few windows near the top. Often it is covered with sheet iron so it will not easily catch fire. Some elevators are tall, round towers of steel and cement. They are built in groups, and roofed with iron.

In every town in a wheat-growing country there is an elevator and a grain buyer. How is the wheat taken from the low wagon bed and put into the high elevator? Did you ever see a link belt? It is an iron chain made of broad links. On each link is a little square steel bucket that holds about a pint. The belt runs over a sprocket wheel at the top of the elevator. The little buckets dip into the wagon. Each one carries a tiny load of wheat up. In a few minutes the wheat is all lifted into a weighing bin at the top. When a load is weighed the wheat is dropped into the elevator tower.

The grain buyer pays the farmer for the wheat, and the farmer pays the bank the money he borrowed and has a good deal left over. The grain buyer has to borrow money now, for he must buy the wheat as fast as it is brought in. He can pay *his* loan when he sells the wheat in big city markets, or to millers. He makes a few cents on every bushel, and the railroad makes something for hauling it. The banks make a little interest for loaning the money. The farmer begins to buy all sorts of things—clothes and food and furniture, and more farm machines. By and by all the wheat money is flowing into all kinds of businesses.

As the country elevators fill with wheat the grain buyers call on the railroads for cars to carry it away. The cars back up on the side track below the elevator. A long canvas pipe, as squirmy as an elephant's trunk, pokes its nose into a car and the wheat flows through it in a golden stream until a car is full. More than a thousand bushels of wheat can be put into a freight car, so it can be hauled a thousand miles for a cent or two a bushel. The wheat takes a journey. It may be stored again in a big city elevator, or it may be poured into the dark hold of a ship and sent across the ocean, or it may go to a mill to be ground into flour.

Flour mills are tall, too, but not so tall as elevators. A hundred years or so ago, mills were never more than two stories high. Wheat had to be carried up to the hopper for grinding, and carried to sieves many times. Boys who were learning to be millers had to have strong backs. An American miller thought it was foolish to carry grain and flour about on people's backs. His name was Oliver Evans. He tied a bag of grain to a rope and pulled it upstairs over a pulley wheel under the roof. Then he thought of tying little buckets on a belt and pulling them up just fast enough to feed the hopper. But after that the flour had to be pulled up again and again for the grindings and siftings. At last he thought that if a mill had as many floors as there were steps in milling, the grain could be lifted to the top, fall from floor to floor, and come out finished flour at the bottom.

Wasn't that clever? Work and time and money are all saved by building mills high. You see the link-belt is used in grain elevators, too. Americans are the cleverest people in the world for making machines do their work. Wheat is moved by machinery from the seed to the loaf of bread. Milling machinery is very wonderful. The grains are crushed between steel rollers. Other machines sift out the brown skin of the wheat seeds, and take out the little germ that

would grow into a new plant. Machines mix the starch cells in the middle of the grain with the gluten cells around them. At the very last the flour is sifted through a silk gauze called bolting cloth. At the top of a mill the dusty brown grains pour into a big hopper. At the bottom soft, velvety white flour runs into new barrels and white muslin bags. It is ready to be made into bread. Every part that has been taken out is turned into something useful to feed animals.

The bread you ate this morning was from wheat planted six months, or a year or more ago. And while you were eating it, farmers by thousands were in the fields putting in seed for next year's bread. Look in the morning paper and see how much it has to say about wheat. It will be on an inside page. There will be a lot of it in fine print. And there will be just as much tomorrow, and next year. The story of wheat is a continued story that is told over and over again, every year. But it is never quite the same story. People are always guessing how it is going to come out at the end of the year. If you ever go to Chicago you must visit the Board of Trade, where wheat and other grains are bought and sold every day by men who guess differently. The men who guess the nearest right, make money by buying and selling wheat.



COTTON. (*Gossypium*)

Native plant from which staple varieties have been derived

COTTON

II. THE WONDERFUL GIFT OF GOOD KING COTTON

Did you ever sing "Dixie Land?" "Dixie" is a loving nickname for our warm southern states, where cotton grows over hundreds of miles of country. The white men who own the cotton fields love their homes, and the cotton plant, and the song. So do the negroes who work in the sunny fields. The song begins: "Away down South in the land of cotton." It is sung to a gay American tune that makes your feet feel like dancing. But you will never know what a happy song it is unless you hear it sung by moonlight in a camp of negro cotton pickers, to the playing of banjos.

A hundred years ago so much cotton was grown in our Southern states, and it was worth so much money that it was called King Cotton, ruler of the cloth market. Cotton is still King, for there is more cotton clothing used than all the wool and silk and linen put together. Our Southern states grow three-fourths of all the cotton in the world. So you see it is "Dixie Land" cotton that is King.

When you think of a king you think of something big and strong, like the oak tree that is king of the forest, or the lion, king of the jungle, don't you? The cotton plant is more like a queen. It is a proud, dainty little bush, very clean and bright, and about four feet high. It is as par-tic-u-lar about the ground under its feet as Queen Elizabeth. You know the story about Sir Walter Raleigh, who spread his velvet cloak on the mud for the great Queen to walk on? Cotton wants soft, warm soil as fine and rich as velvet to grow in, and it will not have common weeds about it. It wants to stand all alone, and have two or three feet of room to spread its green satin skirts. It has a leaf like a three-lobed maple, and a blossom much like a pink holly-hock.

Like a real queen the cotton blossom has several gowns to wear. For its coming out party it has a snow white silk petticoat. The newspapers always mention it, saying: "Cotton is in blossom and looks well." Like wheat, cotton is always getting its name in the papers. It soon gets tired of its coming-out gown and changes it for one of shell pink, then for a rose pink. The blossom does not

fade as other flowers do. At last it turns red. Where the flowers were, are bunches of green balls in husks like hazel nuts. These are called cotton bolls.

For six or eight weeks the cotton bolls swell until they are as big as eggs. The husk turns brown and cracks along five seams. Then it bursts wide, and out pops a fluffy snow ball. The cotton does not ripen all at once like wheat, and sometimes you may see pink and white blossoms, green pods and big snowy bolls all in one field. There is no prettier growing crop in the world than a field of cotton. The picking season lasts from July to Thanksgiving, and a field must be gone over and over.

This leis-ure-ly work in the warm, bright autumn days of the South just suits the sun-loving, happy-hearted negroes. As soon as the first bolls burst open, the negroes swarm out into the fields by thousands to pick cotton. The work lasts three or four months and they make a kind of picnic of it. They move from one plantation to another and live in camps. At night they dance and sing and play the banjo.

A ripe cotton boll when pulled from its brown husk, looks and feels like a soft mass of snowy lint. But if you squeeze it you can feel little hard lumps inside. Pull the fuzzy hairs apart. Every one of them grows tight to a dark brown seed about as big as an orange pit. The boll has as many seeds as an orange. The fibres are all fastened to the seeds, and they twist and cling and mat like felt about them. It would take you several minutes to pull the seeds from one boll, and a day to save a pound of cotton lint.

A hundred years or more ago, all the cotton seeds had to be pulled from the lint by human fingers. That made cotton cost a great deal, even when the work was done by slaves. Then an American invented a machine with rows and rows of little steel fingers. The fingers were set on a sort of rolling pin turned with a crank like a clothes wringer. This machine is the cotton gin (see ELI WHITNEY). The cotton gin of today is a big machine worked by steam. It can clean more cotton in a day than hundreds of men.

The pickers in the field carry big brown bags that will hold many pounds of bolls. When a bag is full it is emptied in a wagon bed. When the wagon is full a man drives away with it to a cotton-ginning factory. (This is generally at a railway station beside the track.) The cotton is weighed and dumped into a big hopper outside the factory. Before you can wink twice, the whole wagon load

is sucked down a big pipe and disappears inside the mill; just as if a giant had swallowed it.

Hurry inside and see what happens! What a dreadful noise, like that chugging, clattering thrashing machine in the wheat field. The air is full of whirling wheels and flying belts, and a snow storm of cotton flakes. Everything is covered with the fleecy stuff. You are white in a minute. Cotton lint lies in big, soft drifts. It has been torn from the seeds by the rows and rows of little steel fingers on the ginning rolls that turn over and over. Brushes sweep the cotton from the teeth. The seeds have been dropped into tanks below.

The seeds used to be thrown away, or burned in the furnace of the ginning factory. They made such a hot fire that it was found they were as full of oil as nuts. It is a vegetable oil like that in pecan nuts, too, with a pleasant taste. So now cotton seeds are crushed. The oil is good for making fine toilet soaps. If refined it can be used for salad oil on the table, and for cooking, and to combine with beef and other fats to make patent butters. The seed-meal, pressed into cakes, is good food for cattle. Cotton seed was rather costly fuel, wasn't it?

When cotton lint is torn from the seeds it is as soft and light as swan's down. For its weight it takes up too much room, and it flies away in the least breeze like thistle seed. So it is carried under steam presses that crowd and squeeze it into bales. Five hundred pounds of it are pressed into a bale four feet square and five feet high. Each bale is wrapped in brown bagging and bound with iron hoops. A great deal of baled cotton can be carried in a car. Big river steamboats carry the bales on open decks.

Now it is King Cotton. It is going on a journey, and it will rule the cloth market. Some of it will go to mills in the cotton country; more will go to larger, older mills in the northern states. But a great deal of it takes a long ocean journey to England, France or Germany. Some of the Dixie Land cotton goes to Japan and China.

Away over in England where no cotton grows, but where there are hundreds of cloth mills, lace works, thread mills and stocking-knitting machines, they watch for King Cotton's fleet of ships from America. In the seaport city of Liverpool, England, there is a cotton exchange for buying and selling cotton lint. It is like the Chicago board of trade, where wheat and other grains are bought and sold. The cotton is bought by sample. Little bundles of lint are carried

around by boy messengers. There is great excitement when a ship load of very fine cotton comes in.

Perhaps you think all cotton is alike. It isn't. There are as many kinds of cotton as there are of apples. Most of the little cotton hairs are less than an inch long, but we have one kind that is two inches long, and very fine and silky. It grows on tall bushes along sea-coasts and on islands, so it is called sea-island cotton. It is so costly, and there is so little of it, that it is used only for thread and lace and the finest lawns and swiss muslins. Some cotton is very white, some a creamy yellow. In Egypt there is a brown cotton that is the best in the world for stockings and knitted underwear. Cotton traders can tell in a minute what a little sample of lint is best for. They buy the kinds their mills need.

A ship load of cotton goes up a wide river from Liverpool, and through a canal, and is unloaded beside the mill that bought the cargo. In the mill the bales are opened, the crowded lint loosened, beaten to a swan's down fluff again, and fanned free of dust. One bale fills a big room, it is so light and soft. The tiny hairs lie twisted and tangled together. They have to be combed, and made to lie all one way, just like your hair. Think of it. They are only as long as the first joint of your little finger, and as fine as spider webs. Yet they have to be combed and made to lie all one way.

The fluff goes through roller combs set with little steel teeth like sewing needles. One row is laid straight, then another behind it, and another until a sheet is formed. The little hairs lie end to end, overlapping and clinging to each other. The fluff sheet is parted into narrow strips that pass through grooves in big steel rolls. Each strip is rolled over and over into a soft hollow rope as big as your papa's thumb. This passes through smaller and smaller grooves. It is squeezed and twisted and rolled, in one machine after another, until it is a cord as big as twine, but still very soft. Another cord just like it is twisted with it to a fine yarn. All this rolling and twisting is called spinning. It makes a yarn ready for weaving. If you want to know how small this yarn is, ravel a piece of muslin and look at just one thread. That is cotton yarn. It would take six such strands of yarn twisted together, to make fine sewing thread.

The spun yarn is wound on big bobbins or spools for weaving. Cloth is woven as you wove paper and splint mats in the kindergarten. The threads run up and down and across, over and under. In a weaving machine the ends of the lengthwise threads are fastened



LEAVES, FLOWER AND BOLL OF KERCHI COTTON (Natural Size) FROM UNITED STATES DEPARTMENT OF AGRICULTURE.



A COTTON-PICKING MACHINE

which does the work of thirty "hands." Revolving cylinders carry steel fingers which pick the cotton fiber, and leave the unripe bolls and the plant unharmed.



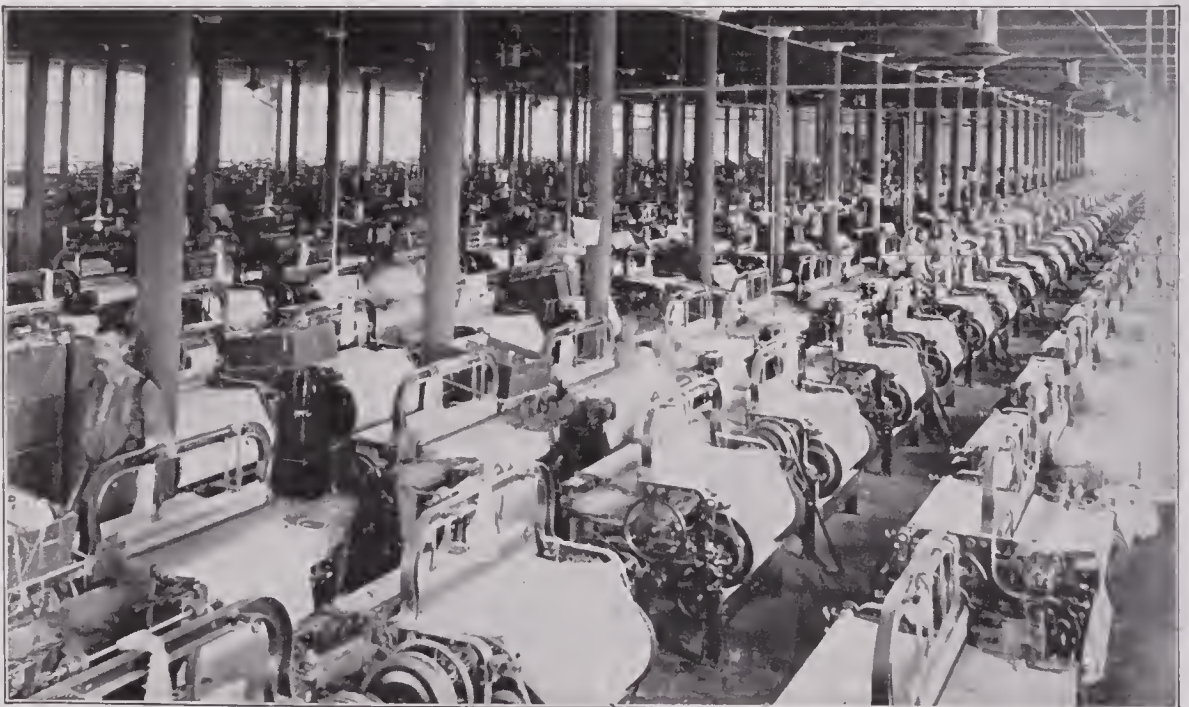
PICKING COTTON BY HAND.



COTTON ARRIVING AT MARKET.



A COTTON GIN WHICH SEPARATES THE SEED FROM THE COTTON.



INTERIOR OF WEAVING ROOM IN LARGE COTTON MILL.

to a roller. The roll is a yard long, and the threads are so close together that, altogether, they look like thin cloth. Every other thread is lifted, and all at once. The odd threads are lowered. A shuttle carries the cross thread between them. Then the upper threads go down and the lower ones up, and the shuttle flies back. In this way miles and miles of cotton cloth are woven by great looms worked by steam power.

How much work has been done since the little cotton seeds were planted. And yet good cotton cloth is sold for a few cents a yard. A great deal of it is dyed, too, or it is printed in pretty patterns. Sometimes, as in dress gingham, the yarn is dyed many colors before it is woven. Some looms weave satin like stripes and dots and flowers on the cloth. Knitting machines make stockings and even gloves, without seams. Linen and silk and wool are spun and woven in much the same way, but these are not so cheap as cotton. It is good King Cotton that gives you most of your clothes.

IRON

III. THE LITTLE PIG THAT GOES TO MARKET

Oh! The baby's little big toe! No, that is just a play to amuse the baby. This is a *real* pig. Then, it's "the squealy little fellow that pays the rent" of the Irish farmer. No, again. That pig is not sold until he is big and fat or he wouldn't bring much money. Another guess—pig iron.

Pig iron! Who ever heard of such a thing? Your papa has, for one. Ask him. Pig iron gets its name in the papers every day, just as wheat and cotton does. Turn any daily paper over to an inside page of fine print headed "The Markets." There you will find the prices of things people have to have, and that are bought and sold every day. Wheat and other grains and flour fill two columns; live stock or cattle, sheep and hogs one column; produce, such as butter and eggs, one column; cotton half a column; metals: ah, here it is—copper, tin, lead, iron. It says: "*The Iron Age* will say tomorrow: Pig iron is rising in price. The iron ore fleet of ships is all on the lakes. Rolling mills are working day and night shifts. Great activity in all lines of iron manufacturing."

What is pig iron? What does it look like? Where is it found? It isn't found. It is made of iron ore, as flour is made of wheat, although in quite a different way. And it looks something like a round, gray stick of stove wood. The story of iron—how it is mined and turned into a pig, how it goes to market and what happens to it afterwards, is long and thrilling.

There is iron in every country in the world. It is all through the earth, the soil, the water and the rocks, and in plants and animals. Some spring water tastes of iron, and is colored brown by it. When iron rusts it turns red. So soil that holds a good deal of iron dust is red, or red brown. Red tile and brick clays are full of iron, and there is iron in your red blood. Doctors give you iron tonics when your blood is too pale. And they tell you to eat spinach and other very green vegetables, because they have iron in them.

Iron is never found in lumps so a blacksmith could dig a piece out of the ground and hammer it into a nail. But in the rock layers

of many mountains there is so much iron that it pays to melt it out. Such rocks are called iron ores. Iron is so useful that men have been melting it out of the ores for thousands of years. It takes such a terribly hot fire to melt iron stone that every ancient people made a wonder story out of how it was first done. The Greeks, who thought different gods did all the hard and mysterious things, had a god of fire called Vulcan. He was supposed to live in a burning mountain where he melted the useful metals, and hammered them into shapes on his forge. That is why we call burning mountains volcanoes today.

If those old Greeks could see the blast furnaces, or volcano towers of fire, and the rolling mills and casting foundries of today, where thousands of tons of iron are melted, rolled, cast, drawn and hammered into shapes, they would open their eyes. The world has learned how to do everything in mining ores, carrying them, melting and working iron, so that iron is now one of the commonest things in use. There isn't any kind of work that men do, from hoeing a garden to pulling a train of cars in which iron is not used.

There are iron mines in a great many of our states. The biggest ones that are now worked are near the shore of Lake Superior. The ore is found deep in the heart of some low mountain ranges that lie from twenty to one hundred miles back, and a thousand or more feet above the water. These mines are very interesting. You have to walk, or ride in a little steel ore car down a sloping tunnel that bores a thousand feet into the mountain. The tunnel is lit by electric lights so it is as bright as the New York subway tunnel. This tunnel into a mine is called the shaft. At the end of it other tunnels run out in every direction. At their ends big rooms have been cut out of the solid rock.

The heart of the mountain is honeycombed with these halls and chambers. There sooty-faced miners work by electric light, electric fans whirl fresh air down the shaft, and steam pumps force out the water of the underground springs that would flood the workings. Miners used to tear down the rock with picks and hand drills, but that is too slow work. Today they use compressed air drills that bore like gigantic woodpeckers. In the deep round holes they put dynamite candles. Far away, so it will take five minutes to burn, they light fuses, as you light the tails of fire crackers. Then they run. In a few minutes, bang! goes the dynamite, bringing down tons of rock.

An iron mine is like the Fourth of July all the time. Boom! Crash! Any minute there may be a terrific explosion that shakes

the mountain, and great falls of rock like falling cities. You would be sure to scream with fright the first time you heard it. By and by, when the dust from an explosion has settled, the miners go back and find tons of broken up iron ore all ready to load into the ore cars. These are pulled up the shaft by cables, and sent down the railway track from twenty to a hundred miles to the lake. It is down hill all the way, a drop of ten to a hundred feet to the mile, so the little ore cars don't need an engine. They just roll along by themselves. The track runs out on a high bridge-like pier for half a mile, and over deep water. There men help the cars dump their loads into ore bins.

Ore ships steam right under these bins. The bottoms of the bins drop on hinges like doors, and the ore tumbles into the holds of the ships. The ships steam away over hundreds of miles of the great lakes and carry the ore to Chicago or to Cleveland, Ohio. From Cleveland most of the ore is sent by rail to Pittsburg, the greatest iron manufacturing city in the world.

To melt iron ores, coal and limestone are needed. The three things are not found together. The limestone and coal are around the lower lakes, and these are nearer the railroads and big markets for iron. The ores on the upper lake can be shipped cheaply. You see the cars run by their own weight to deep water, and vessels can carry things for less money than trains. So it costs very little to send ore from those mines to where there is coal and limestone.

The furnaces where iron is melted out of the ores, are tall towers of iron plates bolted together and lined thick with fire clays that will not melt. The furnaces are often as tall as a six or eight story building. They stand together in a group, each one plumed with black smoke and at night with smoky flames. A stranger coming into Chicago or Pittsburg by night, might think these cities had volcanoes from the glow of fire in the sky above the furnaces.

The inside of a blast furnace is the shape of a gigantic bottle turned upside down. An elevated railroad runs from the dumps of ore, coke and limestone in the vast yards to the tops of these furnaces, and from one to another. On a railed balcony at the top of each are men who see that the furnaces are properly filled. A car load of coke is dumped in, then limestone, then ore, making sandwiches of them. More material is put in, in the same order and amounts, until the furnace is filled. A fire is kindled at the bottom, below the small neck of the bottle. Soon the coke is on fire, a blast of warm dry air is forced through the furnace, and everything inside melts together

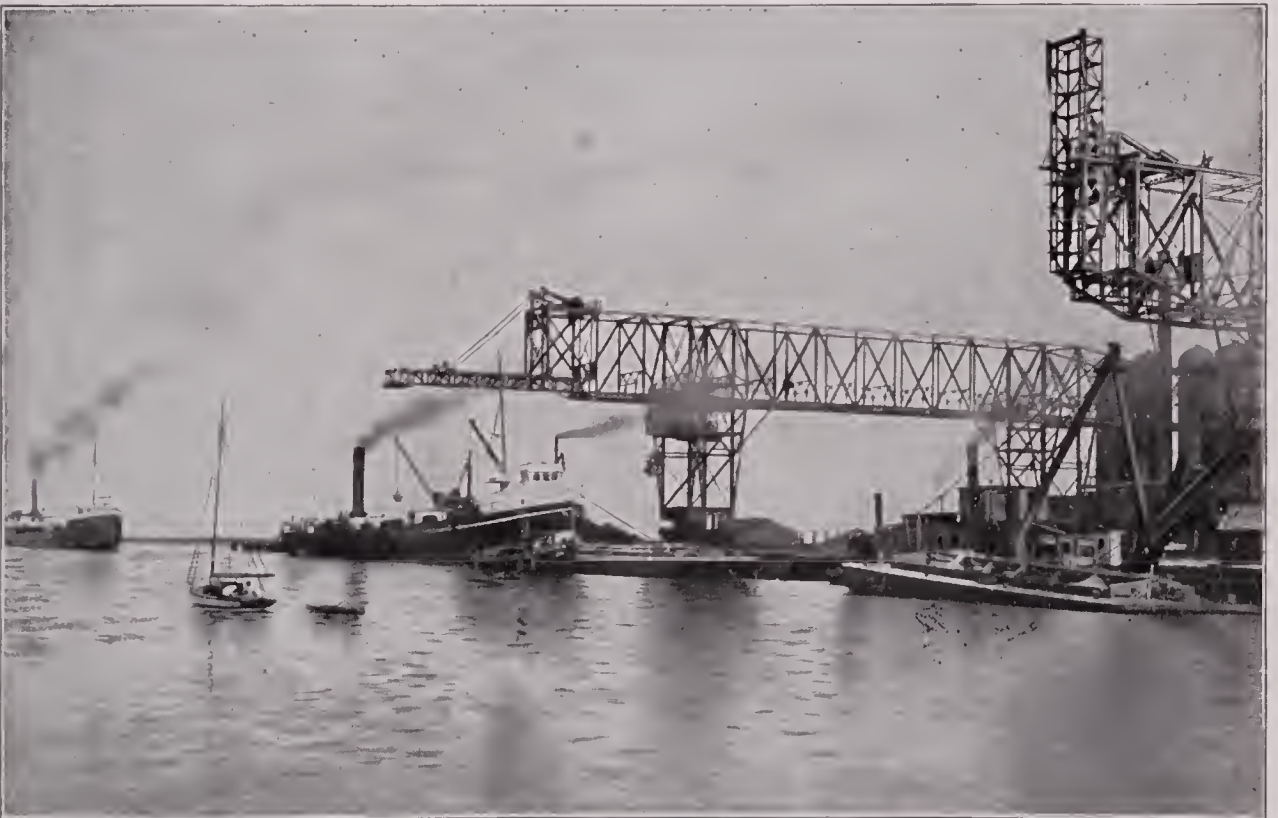
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STEEL MANUFACTURE



Courtesy of Inland Steel Co.

THE ORE—This picture shows a pile of iron ore at a mine in the Mesaba country in Northeastern Minnesota. This region is noted as containing the greatest iron-ore deposit thus far discovered in the world, and also because the ore is near the surface and easily mined. There are several hundred thousand tons of ore in that pile awaiting shipment. Appliances for loading are so perfect that the train of forty cars which you see standing there can be loaded in a few hours.



Courtesy of Inland Steel Co.

TRANSPORTATION TO THE MILLS—Then comes a run at high speed to the head of Lake Superior, only sixty-five miles away ending at the world-famous ore docks. Here a pull of a lever opens the hopper gates of each car, and the whole train can be unloaded in two minutes. The ore is run through the "pockets" of the ore dock into the hold of a great ore steamship, five thousand tons of ore being loaded in thirty minutes. The vessel carries the ore to the ore docks of the great steel mills to which it is consigned. The picture shows a great steel steamer as long as a city block unloading at the docks of the Inland Co., at Indiana Harbor, near Chicago. Here by machinery "grab buckets" are lowered into the hold of the ship; instantly each bucket grabs about seven tons of ore and is whirled upward to the bridge above. Thus ten thousand tons of ore are unloaded at this dock in a single day.



Courtesy of Inland Steel Co.

SMELTING THE ORE—The first process is melting the ore in a blast furnace, in order that the iron may be separated from the earthy matter. This is called smelting. A blast furnace is a huge retort built from fire brick, inside a heavy steel jacket. In the picture you see the blast furnace behind the inclined railroad. It is 85 feet high. It is charged by dumping into it first a charge of coke next a charge of limestone, to act as a *flux* that is to make the ore melt and flow more quickly, and then several tons of ore. The combustion of the coke is aided by a fierce blast of hot air which is forced through it, securing a heat of 3000°, which is necessary to melt the ore. The white hot liquid iron sinks to the bottom and is drawn off; the impurities pass off in slag and gases. Every twelve minutes, day and night, a charge is made by means of steel "skip cars", which run up the inclined railroad and dump their loads into the top of the blast furnace. The four tall steel tanks on the left in the picture are called stoves and are filled with a checker work of fire brick. Waste gas from the top of the blast furnace is carried into these stoves and furnishes a heat which brings the fire brick to a white heat. The gas is switched off, and cold air forced through is heated to 1000° by the white hot brick. It is then driven to the hearth of the blast furnace and assists in reducing the ore.



Courtesy of Inland Steel Co.

TAPPING THE BLAST FURNACE—In this picture we see the lower part of the great blast furnace. The white hot liquid iron sinks to the bottom and, freed from the slag, it is tapped and flows out, as you see in the picture, and is carried into huge brick-lined ladles. Each ladle holds twenty-five tons. Each ladle sits on its own little car and the whole train load is filled at one heat. This train is run direct either to the open hearth furnace or to the pig-casting machines.



Courtesy of Inland Steel Co.

THE PIG IRON CASTING MACHINE—By the old way of making pig iron, it was run out of the furnace mouth into a series of long canals in a sand bed and from these canals into little laterals, where it cooled in "pigs." This method is now displaced by the pig-casting machine. It is a long endless belt with steel buckets on it, each bucket being a mold for a 100-pound pig of iron. As we see in the picture, the ladle car is brought to the casting house, the ladle dumped by electricity, and the molten iron runs through a trough into a moving bucket conveyor. As the buckets move upon a 200-foot incline the molds are drenched in a flood of cold water. At the upper end the pigs are dropped into a car which is flooded with water, to keep it from catching on fire. Pig iron thus cooled is dumped onto a stock pile to be carried to the open hearth furnace when needed.



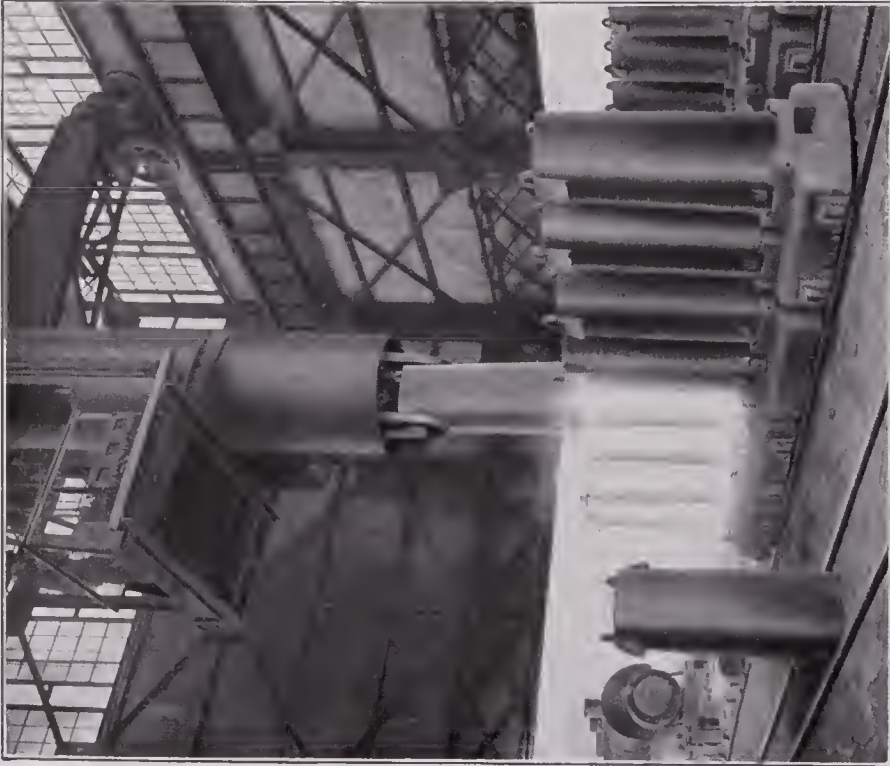
Courtesy of Inland Steel Co.

THE POURING SIDE OF OPEN HEARTH FURNACES—Instead of making into pigs as above described, the molten iron is generally carried in the ladles, direct to the Open Hearth Furnaces. On one side of the row of furnaces is the charging floor. A huge overhead charging machine travels the length of it. A quantity of limestone is spread on the floor of the furnace, then come the ladles carrying the seething mass of red hot iron from the blast furnace. The lower door of the furnace is closed and this molten mass is poured in through an upper door provided for the purpose. In this furiously hot furnace, which reaches 4000 degrees of heat, the iron ore is freed from its carbon, phosphorus and sulphur. Then, since steel must have carbon in it, just the right amount of carbon is added to the melt.



Courtesy of Inland Steel Co.

POURING THE INGOTS—When this open hearth steel is done to a turn, it is drawn off into a huge ladle suspended from the overhead traveling crane. The ladle then moves along the row of ingot molds which you see in this picture. A small trap at the bottom of the ladle is opened and one after another of these ingot molds is filled with the molten steel. The molds stand on waiting cars and when filled they are pulled into the yard where, after they have sufficiently cooled, they are run under the "stripper."

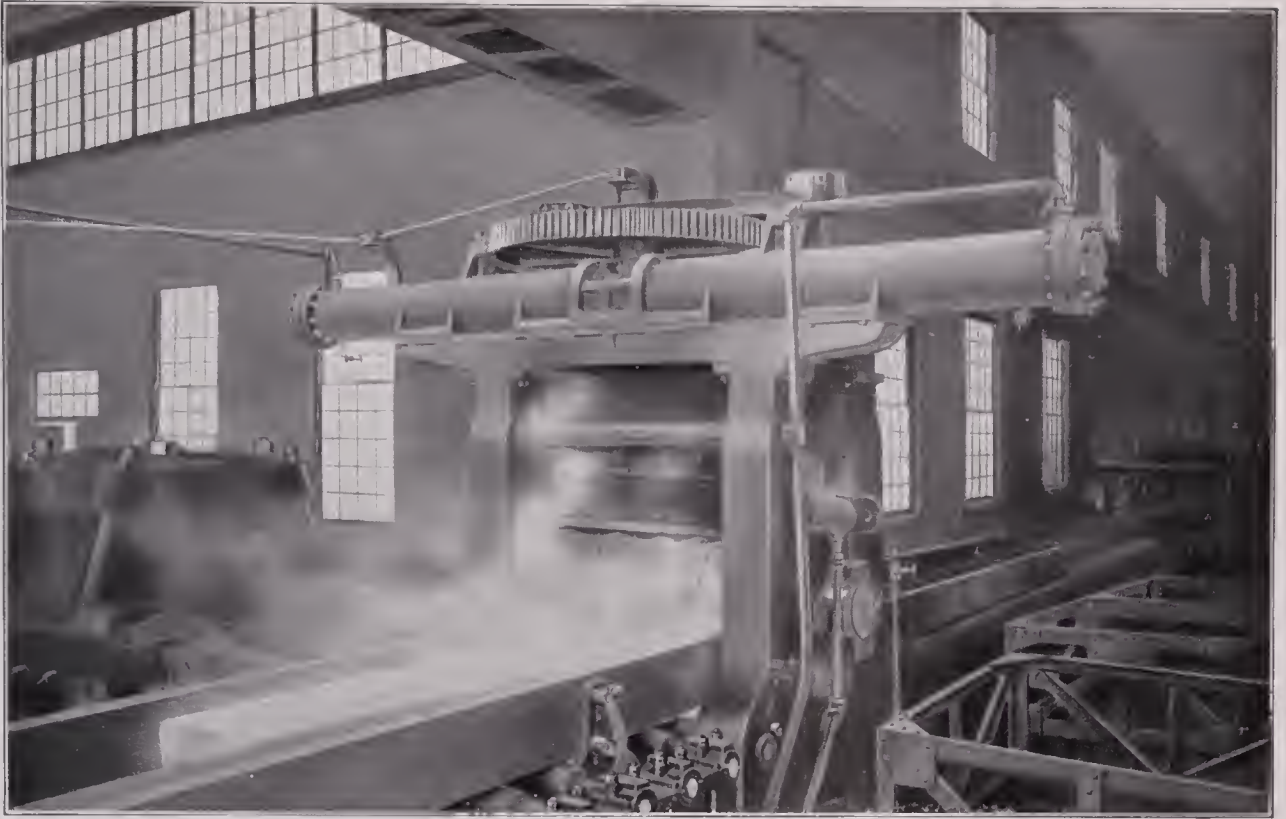


Courtesy of Inland Steel Co.

INGOT STRIPPER—The stripper is a powerful machine that pulls the mold off the ingot. Enormous steel grippers descend and grip the mold near the top, lifting it from the car. Then a steel ram descends and pushes the ingot out through the bottom of the mold, leaving it standing on end, still red hot, on the car, passing on to the next mold till the whole row stands stripped and glowing.



LOWERING AN INGOT INTO THE "SOAKING PIT"—The train of red hot ingots goes on its journey into the rolling mill. Here is a row of "Soaking Pits" sunk into the ground. They are made of fire brick and heated to a white heat. An overhead crane grapples an ingot from its car and lowers it into the soaking pit. This operation is repeated until each of the pits has its full load of ingots in soak. Here the ingots are brought to a white heat and when ready are lifted out and swung over onto the table of the blooming-mill.



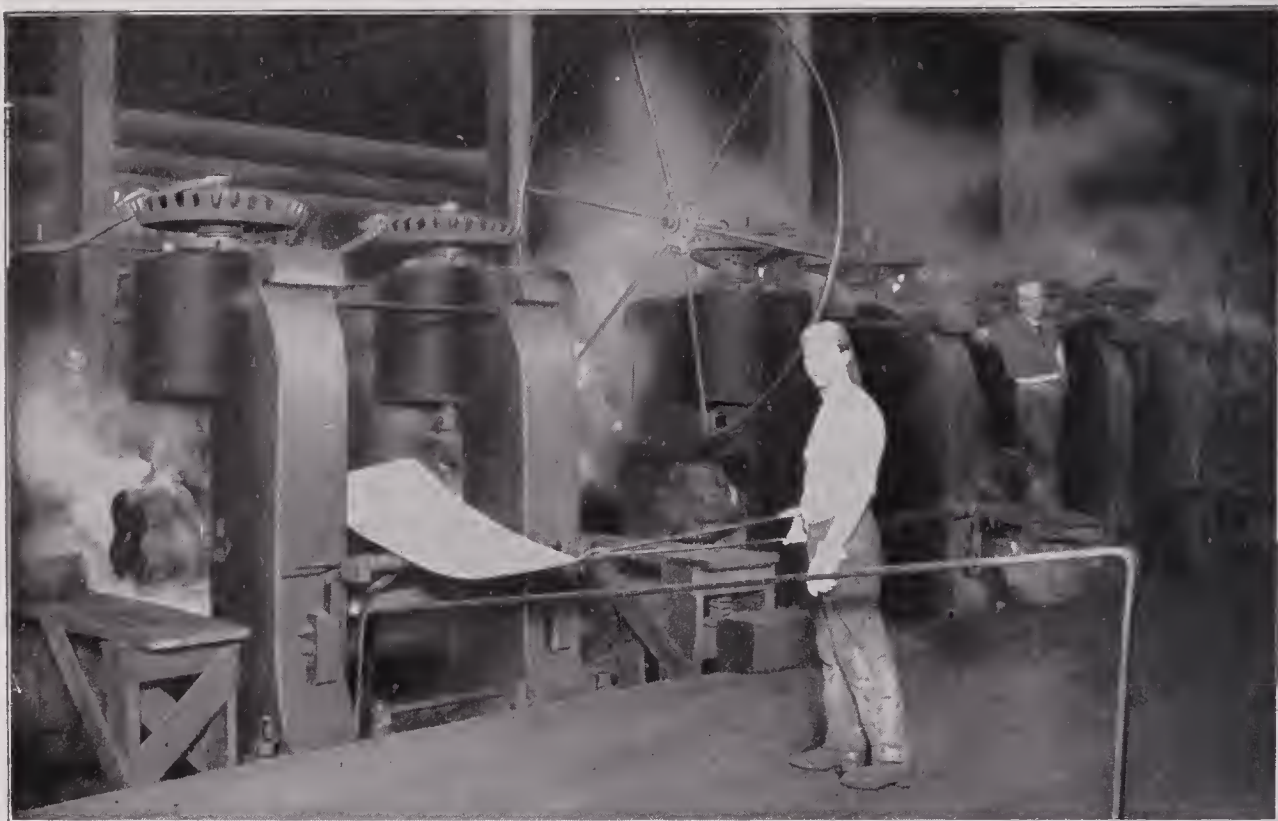
Courtesy of Inland Steel Co.

THE BLOOMING-MILL—The blooming-mill is a big, noisy machine for changing the ingots into shapes required. In the center are huge steel rolls revolving towards each other. Leading to this is a long train of smaller rollers driven at a rapid rate. The instant an ingot is laid on the far end of the table, it is carried to the jaws of the grooved rolls. When it strikes them there is a crash like a cannon shot and the ingot is forced through the rolls and comes out thinner and longer than before. Back again it goes through a smaller groove in the same rolls. Thus it passes back and forth, each time through a smaller groove until it is reduced to a long, flat slab.



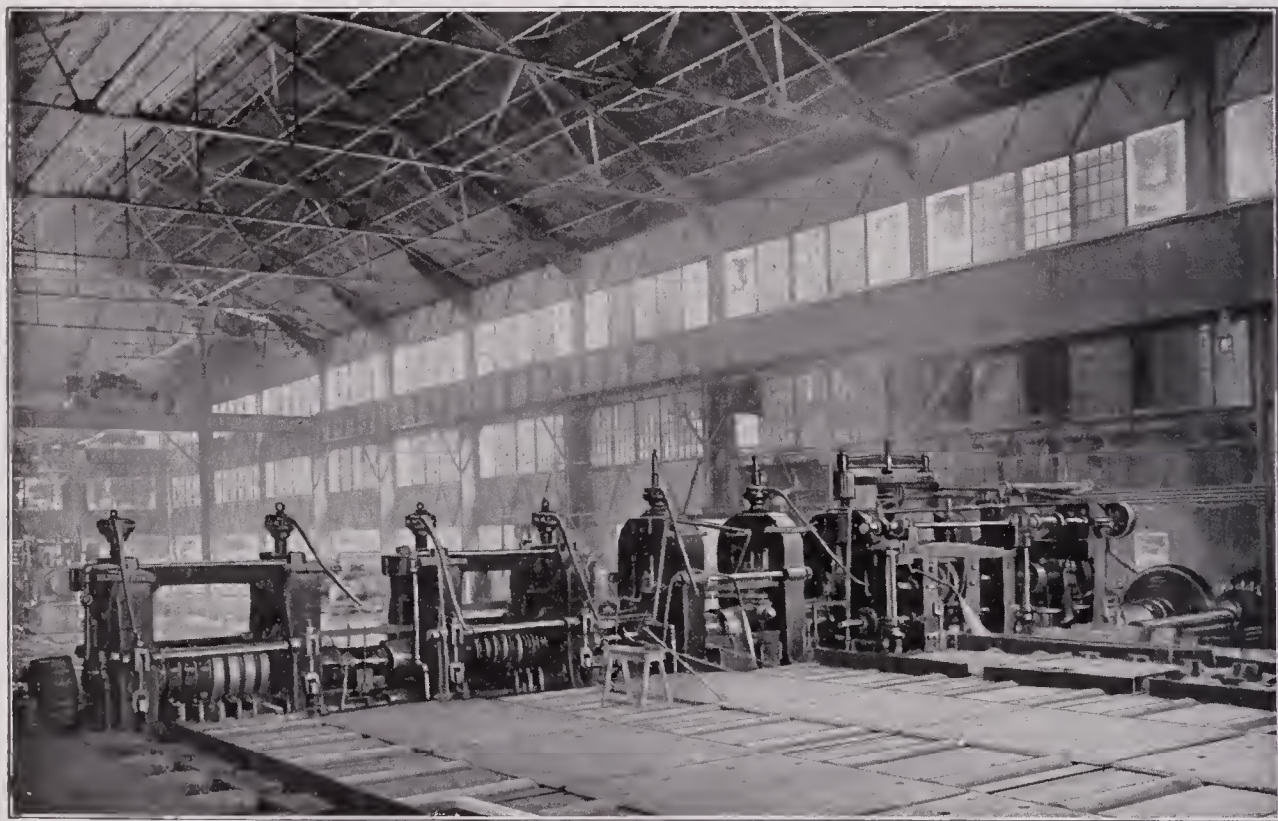
Courtesy of Inland Steel Co.

SHEET STEEL—If sheet steel is to be made, the slabs pass to the table of the sheet bar mill. The same operation as in the blooming-mill is here repeated, though on a smaller scale and the resulting sheet bar is a long snake-like strip of steel. This red hot sheet bar travels onward to the saw which cuts it into 30-foot lengths.



Courtesy of Inland Steel Co.

FIRST ROLLING OUT OF THE SHEET—The sheet-bars are loaded into heating furnaces to be brought up to required heat for rolling. When ready the roller catches the sheet in his tongs and thrusts it between the rolls of his mill. Another worker catches it with tongs and passes it back, and thus it is shot back and forth until it is squeezed into a thin long sheet.



Courtesy of Inland Steel Co.

ROLLING MILL—Here we have a general view of the rolling mill, showing machines for rolling steel into all the many forms required.

in a white heat, just as the sugar, milk and butter melt together and boil when you make candy

When a furnace is ready to be drawn a hole at the bottom is opened. Out pours a bubbling, copper-colored river of fire, into a deep ditch of dry sand. Of all the things that were put into the furnace the iron is the heaviest, so the liquid iron falls lowest in the stream, letting the melted rock and ashes rise to the top. Twenty feet or more from the furnace the ditch is dammed. A hole at the base of the dam lets the iron through into a smaller sand canal. The lighter slag flows away on top into slag cars and is carried to dumps.

The iron runs in a golden stream to a great bed of sand under a shed roof. The bed is pitted with holes a couple of feet long and as deep as a man's arm is thick. These pits, or pockets in the sand, are in regular rows. The iron runs down channels into the pockets. Soon the whole bed is a glowing garden. The pools turn to a sulphur yellow, then to gray and silver as they cool. When they are cold they are clubs of iron. They are raked from the sand and stacked in the yards like cord wood. Those clubs are iron "pigs," or pig iron, and are ready to go to market.

Pig iron is bought by factories to turn into rails, bridge and building iron, machines, engines, locomotives, rods, wire and nails, sheet iron, iron plates for war vessels, guns and cannon, farm machinery and tools, knives, and the thousand and one things of iron and steel that the world uses, from carpet tacks to war ships. Pig iron is simply raw material for making many kinds of iron and steel. You know your mother can make ever so many things out of white flour, by mixing different things with it and cooking them in various ways. So pig iron is melted again and made into cast, or wrought or galvanized iron, and many grades of steel, from bridge and rail steel to the finely tempered kinds used in watch springs and razors. It can be cast in molds, rolled into rails and sheets, drawn into rods and wire, and hammered on forges. Some iron works make only locomotives, some sewing machines, some knives and razors, some sheet iron, or wire, or nails, or plows, or stoves. So foundries and mills need a great many of those little iron pigs.

One of the most interesting kinds of iron manufacturing is the making of steel rails in the rolling mills. In Pittsburg and Chicago rolling mills are owned by the same companies that melt the iron out of the ore in the blast furnaces. As soon as the iron pigs are cold they are loaded on cars and sent over a railroad track in the

yards to other furnaces to be made into steel. This time they are melted in big, pear-shaped pots fifteen feet high and eight feet across. The pots of thick boiler-plate bolted together, are lined with fire clay and swung on beams so they can be tipped over. As the pig iron in the pot melts, an air blast is forced through and makes it boil furiously. Certain things are put into it to change the iron to steel. As it boils crimson flames leap in the air. The flames turn orange, then yellow, then white, then an electric blue-white. At that point the pot is tipped and the dazzling, blue-white, molten steel is poured into oblong moulds.

Each block, or ingot, of steel has enough in it to make a steel rail one hundred feet long. When the ingot is cold it is sent over the yard railroad again to the rolling mill. There it is heated to a bright red, and as soft, nearly, as putty. Tumbled from the furnace onto a travelling table of iron bars, it is suddenly gripped by enormous iron rollers like some giant clothes wringer with grooves in the rolls, and forced through the grooves. There it is squeezed and lengthened and sent on through one smaller hole after another.

The old forge of Vulcan in the burning mountain could not have been hotter, or full of such thunderous crashes, of quivering air and flying sparks as a modern rail mill. The workmen are big men; they are stripped to the waist, and streaming with sweat. With long iron rods they turn and push and guide the glowing blocks of steel from one set of rolls to another. They never speak, for no human voice could be heard in the roar and crash. The last rolls begin to shape the lengthened block into a rail with a broad flat bottom, a curved top and grooved sides. It grows longer and longer, and more perfectly shaped, as it nears the end of the journey. At last it is laid on an iron grating to cool.

Today iron and steel are taking the place of wood and brick and stone in building ships, bridges and fireproof skyscrapers. They are used in the finest palace cars, in making oil tanks, service pipes, bath tubs, expanded lath for plastering, pressed sheets for ceilings and walls, and for lining tunnels. The subway, or underground railway in New York is a double steel tube. Bridges and elevators are hung on wire rope. In old, old times men used stone hatchets. That was called the stone age. Then there was a bronze age when copper was made. Our time is called the iron age because we have learned to do so many things with iron. See IRON, STEEL, ROLLING MILLS.

POTTERY

IV. THE WONDERFUL ART OF MAKING MUD PIES

Isn't it fun to make mud pies?

You get dreadfully dirty, but no natural child minds that. Mama is apt to say that washing dishes is a much more useful thing to do. But you can tell her that if no one had ever made mud pies there would be no pretty white dishes to wash. Bricks to build houses, drain tiles, stone jugs, common dishes and the most delicate painted china cups and saucers and vases and doll-heads, were just mud pies once. They are all made of clay, ground up into flour, mixed with water, shaped and patted and baked in an oven.

You know what pretty things the little tots in the kindergarten can model in clay. All they need is clay and water and ten clever little fingers. So you can readily believe that the wildest people who lived in caves and dressed in skins, and who had no tools at all, could shape bowls and jugs that would hold water and bake them in the sun. There was nothing the people of the earth learned to make earlier except, perhaps, the weaving of baskets of reeds and grasses. Some tribes wove baskets first and lined them with unbaked clay. When they tried to cook meat or grain in these vessels the baskets, of course, were burned. But how surprised and pleased they must have been to find that the clay lining was hardened by the fire.

Then they found that these pots and bowls and jugs were apt to crack if the tiniest bit of gravel was left in the clay. And they found that some clays turned red when baked, some stayed yellow or white. They learned to pound the clay to powder, to melt it in water, to strain out all the little stones through baskets or grass sieves, to dry the melted clay, work it to a powder again, sift it, add water to make a smooth dough, shape the vessels by turning them around and around, bake them in pits, paint them and glaze them with a kind of glass. Indeed, some very simple people in many parts of the world, learned a little at a time by just having to learn, nearly all the things we know about pottery making today. The American

Indians learned these things, the Chinese and the people of ancient Egypt.

Unless these vessels of burned clay were broken by accident, they would last as long as stone. So in caves and tombs, the oldest kinds of pottery have been found in many parts of the world. Some of them are beautiful in shape, in color and in ornamentation, and by studying them we can learn a great deal about the lives and the ideas of peoples who had no written language. Many people think we cannot make any better or more beautiful pottery today than was made hundreds and thousands of years ago. But we can make it more easily and cheaply by machinery, and in many more varieties and shapes, so that everybody can have quantities of it.

In old, old times people mixed the clay and water with their hands and feet. You would have liked that. Mud is so nice and cool and "squishy" between the fingers and toes. But it was rather slow work. The first machine used in pottery making of today is a kind of big coffee mill for grinding the clay to powder. It is called a pug-mill. Pug is from "pucker," a German, or perhaps Dutch word that means to beat, to pound. Very likely the Dutch people invented the pug-mill, for Dutch sailors brought the first "china-ware" from China itself to Europe, and then learned how to make the delicate white ware themselves. But when they had made it they called it porcelain, from the Portuguese name for a shell, "porcellana." Thin white "china" is much like a shell.

Now the Dutch had wind-mills that did the hard work of pumping water, sawing wood and grinding grain. So it was only natural that these clever people should give the wind-mills a new task of grinding kaolin, or white clay for making porcelain. The pug-mill was just a wooden vat, fed from above by a hopper filled with clay. It had an upright shaft in the middle set with rows of strong blunt knives, to cut and beat and pound the clay lumps to powder. If your mother will let you, grind up some lumps of dry kindergarten clay in the coffee mill. It won't hurt the mill, if you wash it afterwards. The powdered clay will fall into the cup or little wooden drawer at the bottom. The pug-mill in pottery works holds a ton or so of clay and is operated by steam with great wheels and flying belts and inside are broad blunt knives that turn on a shaft and chop and beat and grind. It works all the time and fills enormous bins with velvety clay flour, ready to make mud pies.

Such lovely mud workmen make in the big tanks when the clay flour is mixed with water and stirred into a milky paste! Think of the little china bowl you eat bread and milk from, once being an earthy milk itself, then dried to a dough and rolled and shaped and baked like the bread you put into the milk.

When mama makes real bread out of moist dough, she sprinkles dry flour on the molding board. So potters mix a dry flour with their clay dough. Such queer flour! It is ground white flint stone. This stone flour is made in a pug mill, too, but in a covered one filled with water like a washing machine. The flint rock is heated to make it crumble easily. Then it is broken up into little picces and ground in water by a perfect giant of an iron machine that thinks nothing of making stone into flour. As fast as it is powdered this flour overflows with the water into a deep cistern vat. In that it settles to the bottom, and the water is drawn off. Then it is dried and rolled and mixed with clay dough.

Before reading any farther turn back and read the story of how land was made in the first place. Many times before, in the life of our earth, the clay and powdered stone in the hands of the potter were mud. Wind and rain and sun and frost were the grinders, rivers and lakes were settling vats, the bottom of the sea was the molding board; the water above weighed on it and pressed it into shape. And the heat at the heart of the earth melted and baked the hardest rocks. Then it was lifted above the waters, and wind, sun and rain and frost wore it down to mud again.

So in making pottery, bricks, tile, stoneware or porcelain, men only do over again what all the forces of nature do all the time. To make them into cups and plates and jars and doll-heads, the potter must grind the clay and stone again, melt them to paste in water, mix them, shape them while a soft mud or dough, put them into the fire and bake them again into a kind of stone. Isn't that wonderful? It is just as if, in making pottery, men peeped into nature's workshop, learned one of her great secrets and turned it to use.

And just as the sun sucks the water out of the hillside and leaves dust behind, so the potter sucks, or evaporates, water out of his tanks of mud with warm air. Machinery for blowing air is used for a great many things. Your lungs are a model. You use hot air from them to blow soap bubbles and to cool soup. So air blowers are used to clean carpets, to make a hotter fire in a blast furnace, to drill holes in mines, to pound rivets into iron bridges, and to dry

the water out of potter's clay. When the clay is dried to a tough dough the stone flour is kneaded in, and the potter shapes it in moulds, or turns it on a whirling, wheel-like table.

The little kindergartners have a table that doesn't move, and they shape the lumps of clay by turning them around and around. But the potter keeps the clay motionless and shapes it by whirling the table, bringing every side of the clay under his hand as he presses and shapes and hollows out the inside and smoothes the surface. Out of a lump of clay dough a lovely vase shape rises like magic under the potter's skillful hands. It looks simple, but it takes years for the potter to learn how, very quickly and perfectly, to make any shape he wishes.

Saucers and bowls and plates and many, many articles are molded over plaster of paris shapes. For a plate or saucer a sheet of clay, like a rolled piecrust, is pressed on a mould and smoothed on a whirling table by shaped metal scrapers. In making teacups the moulds are lined, as mama lines little patty pans for tarts. The potter smoothes the inside, first with his hand, then with a wet sponge. Handles and spouts are shaped separately and pasted on with a clay cement.

These shapes of clay are set on boards in rows and dried, as you set your little mud pies in the sun. In very old times, and in countries where there was little rain, as in Egypt and on our Western deserts where the Pueblo Indians lived, the people used just sun-dried bricks to build their houses. But they found that water jars must be baked in a fire. All stone ware and the whitest porcelain are baked today in great kilns or fire-clay ovens, and cooled there slowly by drawing the fire so they will not crack easily. You know that cooling or heating suddenly cracks glass and china.

After baking and cooling, pottery is glazed with a kind of glass. Some of the pieces are decorated before glazing, some after, by printing colored or gold bands or flowers on them, or by painting with metal powders and oils. Then it is baked again. With that glass skin on it, sun, wind and dust cannot mar the most delicate porcelain vase or cup. It is such a pity that so beautiful a thing, that it has taken so much work and skill to make, can be broken so easily by a careless person.

In many museums in our country and in the old world you may see the earliest Indian, Egyptian and other primitive, unglazed pottery of strong colors, and quaintly shaped and ornamented. And

you may see the most exquisite Chinese, Japanese, Greek, Italian, Dutch, French, English, German and American art wares. For hundreds of years many peoples have been making pottery and porcelain too beautiful and costly for anything except to look at, as we look at paintings and statues. The clays were mixed, shaped, fired, painted, enamelled, polished, glazed and fired again by great artists. The finest examples are marked with the makers' names burned in. And oh, what hero stories there are of famous potters, who worked years, and failed and suffered and at last succeeded in this lovely art.

Pottery making is one of the few things very little children can do, and do well. In its simplest forms it needs as cheap materials, and as few tools as basket making. Modeling clay comes among school supplies ready for use, too. In many places are kilns where schools can have pottery fired. And there are models of very old, simply shaped pieces to copy, and old patterns of ornament that grew out of the lives of ancient peoples. So as you shape and paint and dry the jar or bowl or vase, you live again the history of the earliest workers in clay, and learn principles of form and ornament that are used in many arts.

That kind of playing mud pies is useful and beautiful. Anyone can *wash* a dish after it is made, but just ask mama to read this story and then say if she thinks she could *make* a dish. (See POTTERY, PALISSY, WEDGWOOD.)

WOODWORKING

V. WHEN A TREE IS LUMBER

Have you a wooden top to spin? As it spins, it stands upright on its tip. But the first time your top spun was when it was made. It was held between two pivots and whirled side ways. Spinning wheels are used in shaping rounded articles of wood, just as they are used in shaping clay. The clay worker's whirling table is called the potter's wheel, but the wood worker's spinning wheel is called a lathe. In every house are examples of the wood turner's work—in chair and table legs, in the spindles of stair and porch railings, and in the supporting columns of arches and mantels; yes, and in croquet balls and mallets and tenpins.

The very first lathe that men made was like a top in one thing. It was kept spinning with a string. One end of the string was fastened to a pole near the ceiling. The other end was wrapped around the block of wood that was to be shaped, and tied to a treadle. The treadle was kept going by the workman's foot, just as your mama runs her sewing machine. The block of wood to be turned was clamped between two pivots and whirled with the wheel. As the block whirled toward him the workman pressed the sharp blade of a chisel against it and cut the wood away.

The very simplest of old wood turning hand machines were called lathes. We do not know whether the word came from lath, the light pole that held the string, or from an old word that meant frame to hold things, or from lade, "to load;" for the lathe is a frame, and it carries the load or the weight of the wood that is being shaped. The machine lathe of today, operated by steam power and working automatically, or self-regulatingly, is made on the same principles as the treadle spinners of the earliest woodworkers.

The pole and the wheel and string are gone, of course. In their place are cone-shaped pulleys and flying leather belts. Cone-shaped pulleys are several wheels, each one smaller than the last, welded together into one, and making a stepped cone. By shifting the belt from one wheel of the pulley to another, the workman can turn on slow or rapid power to suit the hard or soft wood he is carving, and

THE LUMBERING INDUSTRY

The first stage in the lumbering industry is known as logging. Formerly the trees were felled in the forest in the winter, hauled on snow sleds to the streams, where they were piled on the banks, and in the spring, when the streams were free from ice, they were floated down to the mills. Most of the northern forests were cut and transformed into lumber by this method.



Here is a typical lumber camp. These log houses or huts, the cracks plastered with clay, form snug, warm quarters for the army of loggers who live in them through the winter.



Here we see men felling the trees. You will note that one of these men is right-handed and the other left-handed, so that they stand side by side and chop on opposite sides of the same tree. Sometimes the trees are cut down by a crosscut saw instead of an ax.



After the trees are felled they are cut into logs of proper length with a crosscut saw, then they are gathered together and loaded onto strong, wide sleds and are hauled to the streams. Here we see a number of teams hauling immense loads of logs over the deep snow. It requires both hard labor and skill to build these great loads symmetrically so that they can be hauled safely.



Courtesy Doubleday Page & Co.

In the spring when the streams are at flood an army of loggers, often called Lumber Jacks, roll the logs from the bank into the stream, to be carried down by the current. Often the logs carried swiftly down the stream meet some obstruction, a jam is formed, and the logs are piled up into a tangled mass, as we see in this picture.



When the logs reach the lower and larger streams, they are gathered and fastened into long rafts and finally moored in the mill pond. Here they are held in place by what is called a boom, which consists of a long string of logs held together end to end by strong chains.



Courtesy Doubleday Page & Co.

Now comes the Lumber Jack the test of courage, strength and skill. With shoes heavily spiked they step out on the jam of logs and, at the risk of life and limb, with long spike poles and cant hooks called peaveys, they dig and tug away at the logs that are on the lower side of the jam, loosening them and setting them afloat. The single log on which they stand often twirls under their feet and only their skill and the spikes in their shoes save them from destruction.



Courtesy of Clyde Iron Works

The engine moves the skidder with frequent stops along the track and thus all the logs on each side of the spurs are hauled up to the side of the railroad, as we see in this picture.



Courtesy of Clyde Iron Works

Here we have a picture of a McGiffert log loader which loads the logs onto the cars. It is so built that it may run along the same track on which are the cars to be loaded. It is so made that the trucks can be lifted up, the machine resting on legs, and thus a passage way under the machine is provided, so that the flat cars can run under the machine, as through a tunnel, until the forward car is brought under the boom. Logs are lifted by the boom and placed on the car. When the car is loaded the train is pulled forward so that the next car is in position for loading. This process goes on until all the cars are loaded. Then the machine is let down so that the wheels rest upon the track and the train is moved where desired.

MODERN LOGGING



Courtesy of Clyde Iron Works

In modern lumbering a railroad is run through the forest to be cut. From this main line are extended on either side branch roads, or spurs, at intervals from 1,000 to 2,000 feet. The road and the spurs are constructed in a cheap, temporary way. The trees on each side of the spur track, back to a distance of 500 to 1,000 feet, are sawed down and cut into logs, as shown in this picture.



Courtesy of Clyde Iron Works

The machine shown in this picture is called a skidder. It is run along the spur track and draws the logs which have been cut to the railroad. The skidder is a steam machine mounted on a steel frame like a flat car and has long steel booms at each end. A steam boiler is set in the middle of the machine and there is an engine at each end provided with drums on which wire cables are wound. The cables run from these drums to the end of the booms through blocks and are taken back into the woods by means of lighter cables, which are also wound on drums. The logs are attached to the skidding cables and drawn to the track by winding up the cables on the drums.

the easy or difficult pattern that is to be cut. The frame that holds the block or bar of wood between the pivots can be shortened and lengthened by a sliding bar in the bed of the lathe.

Automatic or self-regulating lathes are called "copying" lathes, because they copy patterns set for them, making millions of chair legs and stair spindles exactly alike. They work very much as the keys of a piano player are moved, by little knobs catching in the holes in the long paper rolls. You know you could play one tune over and over until the roll was worn out. Of course the carving chisel is held and moved by machinery too.

All that the "turner" workman has to do today is to feed the machine with the wood blocks and shift the belt from one wheel to another. This is true in all kinds of factories. Less and less skill is needed in the workman and machines do the work of dozens and hundreds of men. Of course this gives us more things to use, but hand-made furniture and shoes and clothing and pottery is still the best. Beside lathes for turning rounded articles, there are lathes for boring holes and for making pegs by which parts of furniture are held together. There are lathes for cutting grooves, and for "dove-tailing," or tooth-notching the ends of boards that are to be joined to form boxes and bureau drawers.

In woodworking shops a very important tool is the planer for smoothing sawed planks. A carpenter lays a plank on a bench and uses a hand-plane or a draw-knife to peel off long, white, sweet-smelling curly shavings. In the factory the bench is a travelling table that carries the board under the chisel-blade of the planer. Then, as a carpenter sandpapers a board that must be made very smooth, so there is a machine for sandpapering. It is a broad travelling belt or drum coated with emery, or steel dust. It whirls over the planks and leaves them as smooth as satin.

The very first tool that a tree makes acquaintance with when it is to be turned into lumber, is just a woodman's axe, and then a cross-cut saw, both worked by hand. A man who knows, from the look of a tree, whether it will make good lumber or not, goes through a forest that is to be cut over, and marks the trees that should come down by cutting a chip from the trunk. After him come the sawyers and choppers. In our big American forests lumber camps are set up in the winter, with an army of men and horses. There is a man cook for the camp, and a blacksmith, and there are sledges and derricks and an armory of saws, axes and iron chains.

After the marker come the sawyers with long, cross-cut saws that are pulled back and forth across the tree by two men. They saw part way through. Then choppers cut from the other side of the tree. A tree falls on the cut side with a crash. The choppers have to jump, sometimes. The trimmers follow to chop away the branches, big and little, and to cut off the slender top. At last there lies a mighty log, fifty, one hundred or more feet long. It may have taken it a century or longer to grow. It lies on the earth often as heavy as iron. Sometimes, as it lies there, it has to be sawed into two or three logs before it can be moved. The logs are lifted with derricks onto the low broad sledges and hauled to the nearest river.

But first a road has to be made for the sledges. A snowy track is cleared of stones, trees and underbrush and is packed hard by the horses and sledges. Then it is flushed with water and let freeze. If it runs down hill and has no turns, it is a sort of "coaster" that makes the work easier for the horses. In the northern woods from Maine to Oregon, the logs are rolled down the banks of streams onto the ice. Then, when the ice breaks up in the spring, the logs go down on the flood to the saw mills. Drivers go with them, riding on the tumbling logs, guiding them with long iron rods, keeping them from piling up and jamming. This is very dangerous work, so log drivers get high wages. They bring the logs over the rapids and dams and down to the saw mills. In our Southern pine woods where there is no snow or frozen rivers, the logs are not moved at all, but the saw mills are set up in the forest, and moved when a section is cut over.

Some of the big red-wood trees of California are thirty feet thick. That's as thick as many a two-story house is high. They have to be sawed into several logs by enormous saws and then split with dynamite so they can be handled at all. Mahogany trees of Cuba and the hot countries of America often grow on mountainsides a hundred miles in the country. They are very heavy, hardwood trees, often one hundred feet high, yet entire logs are got down to seaports, just by men and oxen, working with clumsy tools and solid-wheel trucks. Rosewood is brought out of the hot jungle along the Amazon River in South America. It is cut into ten foot logs, split, built into rafts and floated to the seaports. Teak logs are dragged out of East Indian forests by elephants. In nearly every country of the world are timber woods so valuable and beautiful that they are got to market at the greatest labor and expense.

When any tree is first cut it is "green," or full of sap. To be useful for lumber it must be seasoned, or dried. Sometimes, and with some kinds, as with teak, the tree is girdled by cutting a belt all around it and allowing it to die standing. A log is never allowed to lie on moist ground by good lumbermen, for then it would be attacked by insects and fungi, or toad-stool-like growths, and would quickly begin to decay. In our country logs are usually hurried to a saw mill and squared. That is, the bark is sawed away on four sides. Oaks are often quartered, that is, cut across the middle both ways, making four logs. These logs are then piled up in lumber yards for open air drying, or they are sawed into planks and then seasoned.

Two kinds of saws are used in saw mills—the circular and the gang saw. The circular saw is a big toothed steel plate that revolves, cutting through a log as it turns. The gang saw is made up of a number of blade saws set in a frame like the blades of a safety razor. The "gang" goes through a log and cuts it into planks in one journey. The barrel saw used in cooper shops earns its name twice. It is shaped like a barrel stave and is used for cutting the curved staves of barrels, kegs, hogsheads and water pails. The band saw of furniture factories is really a flexible band or belt of steel, that turns over pulleys like a leather belt. It is used for scroll sawing, in making such things as the open-work music racks on pianos.

And now, here is something very odd about saws. When men first began to make saws they set flint stone teeth into wooden blades. When they learned to make bronze, saw blades were cast or molded with toothed edges. Steel saws had the teeth cut on the blades. But it was discovered that the teeth wore and were sharpened away very fast, so the saw became constantly smaller and, by and by, useless, although the blade was perfectly good. Steel was made harder and harder, but still saw-teeth broke and wore away, in having to go buzz-zipping through hardwood logs. Then saw makers went back to the old, old idea of false teeth for saws. The teeth are made separately and set into the blade. When a tooth breaks or wears out a new one goes in. Doesn't it seem strange that our latest saw goes back, for its new idea, to the flint-toothed wooden blade of primitive people?

Have you ever seen a lumber yard? The planks are piled up in tall stacks, but every plank is separated from every other one by a cross-piece. This is to allow the air to get to every surface to season

the wood. Often shed roofs are built over piles of lumber to protect them from sun and rain that would warp and rot them. Wood is made stronger and more durable by seasoning. If not well dried, wood splits and warps after it is made up into furniture and house fittings. Slow drying in cool air is the best seasoning of all. After air seasoning, many fine cabinet woods, like mahogany, are sawed into boards a quarter of an inch thick or less for veneering, and then kiln-dried, or baked, in warm-air ovens.

Great pains is taken to kill all insect life in wood. Ship timbers are soaked in brine. Some woods are steamed and dried. Some have the bark charred with a gas jet. Shingles are soaked in creosote to make them damp proof. Exposed wood is painted with lead paints or tars. Fine furniture woods and floors have their pores filled with resins, and are then steamed and varnished to protect the surfaces and to bring out the beauty of the grains.

How many woods do you know after they are made up into useful articles? Nearly all of them are stained, even the finest of the hardwoods. In furniture we like darker colors than are natural in the woods. Oak is yellow, from almost white to an ochre, but we stain it all shades of brown. Mahogany is a light red that darkens with age, so we stain it a dark red. Birch, a yellow wood, stains to a good imitation of mahogany. Pine and ash take any stain, even the art colors of forest green and russet brown. Teak is a brown wood that the Chinese wood-carvers stain an ebony black, then carve and inlay with mother of pearl. The walnuts are stained soft, dark browns. White mahogany and bird-eye maple are two woods that are more beautiful unstained. But, as a rule, stains in acting unevenly, bring out the grains, the rays and curls in wood in greater beauty than if they are left in the natural colors. (See FORESTRY, FOREST-RESERVES, LUMBERING.)

MATCHES

VI. JUST TO LIGHT A FIRE

When the Puritans came to America they had to bring everything you could think of with them—even pins and needles and—matches?

Oh, dear no! There were no matches in those days, even in the old world. A tinder box was used to start new fires, and candles were lighted at the fireplace. It was a solemn thing to watch the father of the family start a fire. He took a little iron box down from the high mantel shelf. Inside of it were a bar of steel, a flint stone, a bit of charred linen, or “tinder,” and a bundle of wood splints tipped with sulphur. He struck the bar on the stone. A starry spark flew off on the tinder. Slowly a glow spread over the tinder. It did not burst into flames, but became hot enough to set fire to a sulphur-tipped splint. The splint was thrust into a handful of shavings and the blaze carefully fed into a fire with kindlings and pine knots. It was such a trouble to start a fire with a tinder box that coals were kept over night under ashes. If a fire went out a little boy was apt to be sent with an iron kettle, a mile away to borrow fire of a neighbor. Hunters learned to start camp fires as the Indians did, by rubbing two sticks together. Why, even Washington, who died nearly two hundred years after the Puritans came to America, never saw a match. And now we can buy a box of matches for a few cents.

It seems very odd, now, that matches weren't made long before they were, for people knew all about the two things necessary for making them. They knew that friction, or rubbing or striking things together, make them hot. And they knew that phosphorus and some other chemicals catch fire very easily. But it was only about a hundred years ago that phosphorus was melted with other things, and then hardened in little balls on the end of wood splints. And even then the matches would not burst into a blaze when struck on a rough surface. With the first boxes of matches came a little bottle of acid. The match was set on fire by touching it to the acid.

Then the acid was put into a tiny hollow glass bead on the tip of the chemical soaked match. To light that match the glass was broken with a pair of nippers. Many of your grandfathers can remember the first friction sulphur matches. They were lighted with dreadful fumes that made one sneeze, by drawing the heads between folded sandpaper. Now you will want to know about how our safety matches of today are made, in big factories and by steam machinery.

The most interesting and difficult thing about match making, the one that takes the most and the biggest machines, is the making of the little wooden sticks. Some match sticks are round, others square. The two kinds are made in quite different ways. The round ones are made by—well, did you ever see your mama make “riced” potatoes for dinner? She boils the peeled potatoes. Then she forces them through the little round holes of a fruit press or “ricer.” They come through mashed into fluffy strings that fall into grains like rice. A block of very soft wood, like pine or poplar, is forced endways through a steel plate punched full of round, sharp-edged holes. In that way the block is pressed through into round match sticks. Of course any wood is a great deal harder than boiled potatoes, so it takes a powerful machine to force a perforated steel plate, buzz-zip through a block of wood two and a half or three inches thick.

To make the square match sticks, a round block of wood quite twelve or fifteen inches long is turned against a strong knife blade of the same length. The block is peeled away in a continuous ribbon of wood, just as thick as a match, until it is all peeled away, and no core is left. The ribbon is cut lengthways into five strips. Then the wood ribbons are fed to a machine that chops them into matches. One machine can chop off 10,000,000 match sticks in one day.

After chopping, the sticks are dried with hot air in a huge whirling oven. If your kitchen stove should turn on its side and begin to roll over and over, that would be something like the revolving drum in which both round and square match sticks are dried. The oven is made to whirl for the same reason that you shake your popper when popping corn. It is to make the sticks dry evenly. In tumbling about together, too, splinters and rough edges are knocked off. Big drums are used a good deal in factories. In creameries the churns are big, whirling drums. In iron foundries, iron castings are put into a “tumbling barrel” to knock the rough edges from each other.

After drying, the match sticks are shaken in sieves that sift out splinters and broken pieces. The good match sticks fall down into little places that are partitioned off, and lie side by side, as straight as in a box. Then a machine that seems almost to have brains in its little steel fingers, picks up a bundle of sticks, fastens them like pegs in little holes, each one separated from every other one, and gently lowers fifty or a hundred at a time, into melted paraffine wax, then into phosphorus mixed with other chemicals.

As soon as a dripping frame full of matches is lifted from the phosphorus vat, it passes along a belt into a blast of cold air. This dries the heads quickly. A little farther on the dipping frame lets go of the matches. They fall, heads all one way, into another machine that puts them in neat rows into boxes.

The pasteboard or strawboard boxes are made in the same factories. An endless roll of brown strawboard is fed in a broad sheet to a machine that cuts it into strips wide enough to make the four sides of a sliding box cover, or the bottom and sides of the box. Through one machine after another these strips go. The box cover is given four folds and pasted into a square-sided endless tube. The tube goes through a special printing press that prints the top and bottom and one side, and pastes a strip of sandpaper on the fourth side. Then the printed tube is cut up into box-length. Five hundred to a thousand boxes can be made every minute in a big match factory. A thousand boxes must be made every minute for ten hours every day to supply enough boxes for 100,000,000 matches. About one hundred and sixty matches are put in the ordinary box, and one dozen boxes in a package. Such a package is often sold for as little as eighteen or twenty cents. That is about a penny a hundred. Very old people can remember when matches were sold by the dozen, and people rolled paper lamp-lighters to save matches.

A match lighted in the dark is a sort of little star. The phosphorus on the head that flashes so instantly into flame, was named for a star, too. The Greek people called the morning star Phospho'rus, or light-bearer. When a substance was found in the earth that, united with the oxygen of the air, glowed or even burst into flame readily, it was named for the star. Now, of course, it would never do for Nature to leave so dangerous a thing lying about in lumps by itself. Phosphorus is always mixed with other things. For example, it is mixed with lime in your bones, and with tissue in the nerves and the brain. In match heads we want something that

will light instantly on being struck, but that will behave itself at other times. Forms of potash and of manganese mixed with phosphorus help to make better and safer matches. The very best matches of all are the "safeties," that cannot be lighted anywhere except on the sand panel on the box. That is because the phosphorus is not on the match head but on the panel.

Another thing that makes safety matches safe is that red phosphorus is used. That is the most expensive, but the cheaper kinds of phosphorus are poisonous. Babies have been poisoned by biting match heads. You know a baby puts everything into his rosy mouth to see if it is good to eat. Cheap matches are not only very poor things, and dangerous to have about the house, but the workmen who make them are poisoned. They get a disease that softens the bones. Nowadays we think a good deal about the way in which other people are treated, and the conditions under which they have to work. In some states the poisonous kinds of cheap phosphorus are not allowed to be used, and if everyone refused to buy such matches at all they wouldn't be made.

In the study of Chemistry, that you will take up when you get into high school, you will learn many more interesting things about phosphorus and the other substances in match heads. Some day, some bright American boy who studies hard and makes experiments in chemistry, is going to invent a strike-anywhere safety match with no phosphorus in it.

Edison could do it, very likely, if he gave his mind to it. Do you think you could?

HOW MATCHES ARE MADE



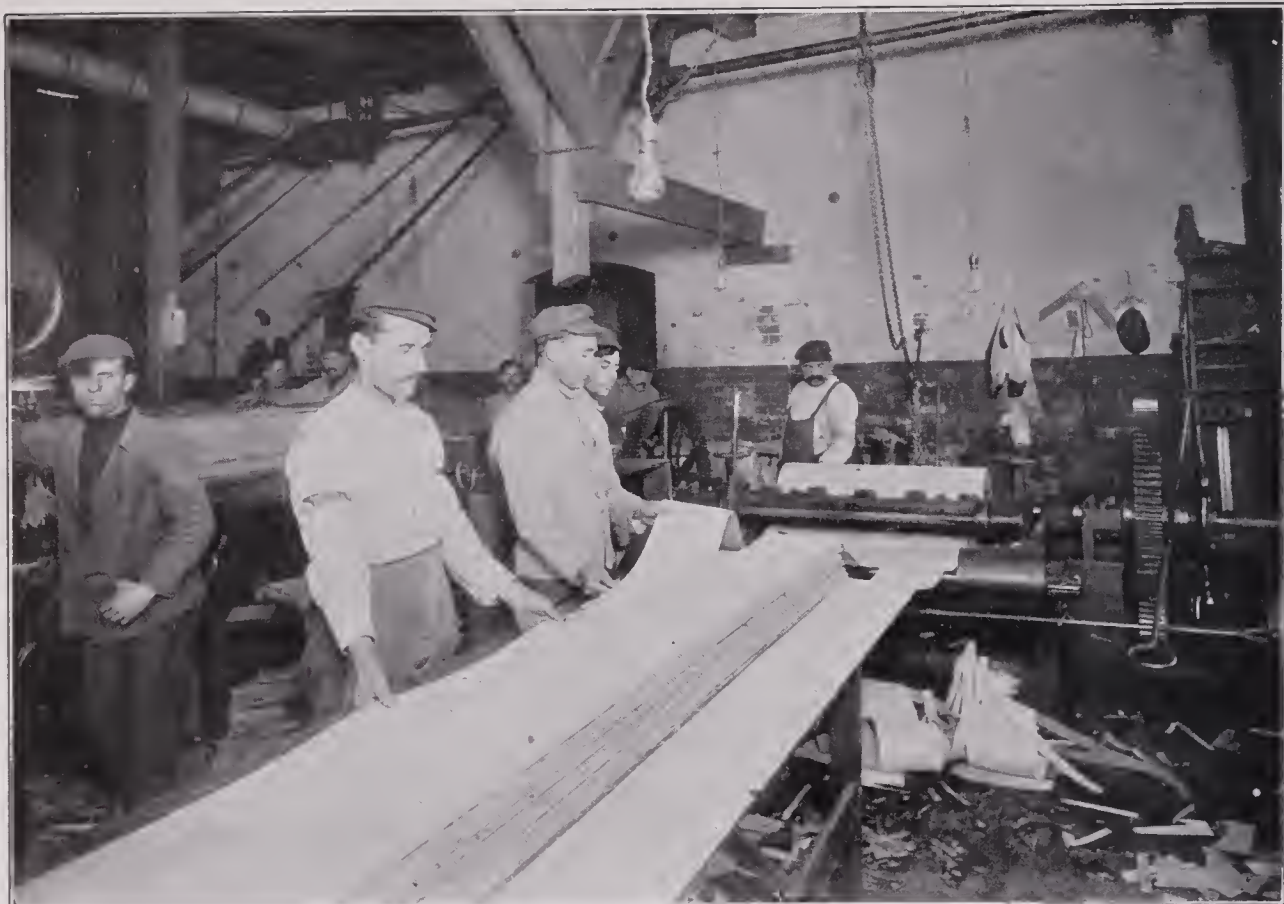
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Here we see a log of soft wood which furnishes the material from which matches are made. The first process, as shown in the picture, is cutting the log into short blocks.



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Here the blocks are being prepared for the veneering machine. The bark is split off and the surface is trimmed with an ax.



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Here we see the veneering machine. The block is put into the machine and is turned against a strong knife which peels or shaves the surface into long ribbons of wood of the thickness of the match.



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These ribbons or veneers are placed in the chopping machine where they are chopped into splints the size of a match. The picture shows the splints dropping into a large tray, as they fall from the chopping machine.



Copyright by Brown Bros.

The splints are next placed in the kiln for drying. Here we see a tray of splints being put into the kiln where it will remain for an hour, until the splints are thoroughly dried.



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On the wall you will see the sign, "Employees must have their teeth filled." This is made necessary because the fumes of the phosphorus used in the manufacture of matches is a poison which finds its way into teeth cavities and causes what is called "Phossy Jaw," a serious and fatal disease. After the splints are dried, they are placed in the straightening machine which we see in the picture. Here they are tossed to and fro, which causes them to fall into the grooves, as shown.



Copyright by Brown Bros.

After the splints have been straightened, they pass through a machine in which little steel fingers fasten the splints in little holes in the trays, each separated from the other. Here we see the splints in trays, ready for the dipping machine. You see a man sliding the trays into the machine. Then they are started on their way to the composition tank.



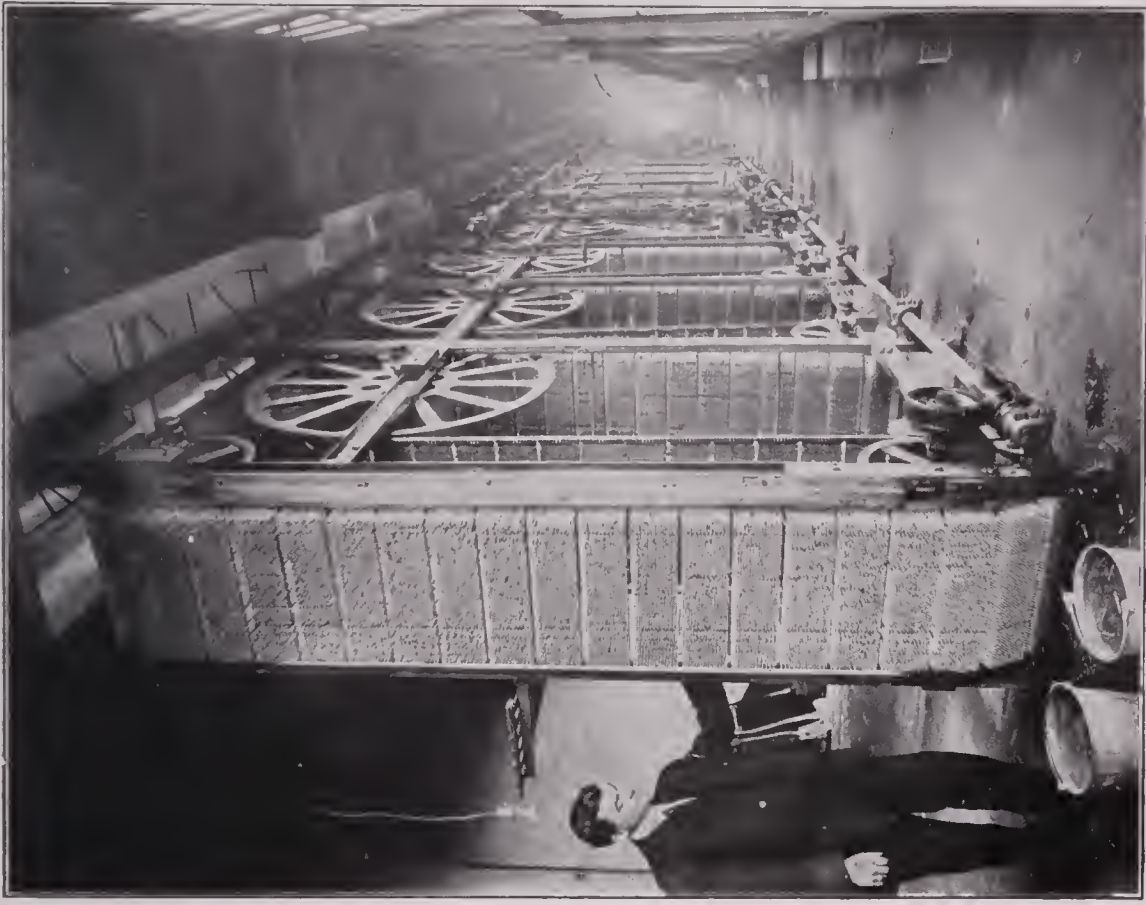
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The ends of the splints must now be dipped into a composition of phosphorus and other chemicals. In this picture we see a man preparing the composition by mixing the different chemicals in their proper proportion.



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In this picture we see a man pouring the composition into the dipping tank. You can see the tank which contains the composition and just above it the trays of matches on a revolving belt, moving over the tank so that the tip ends of the matches are dipped in the composition. They are then carried by the belt up into a blast of cold air which quickly dries the heads.



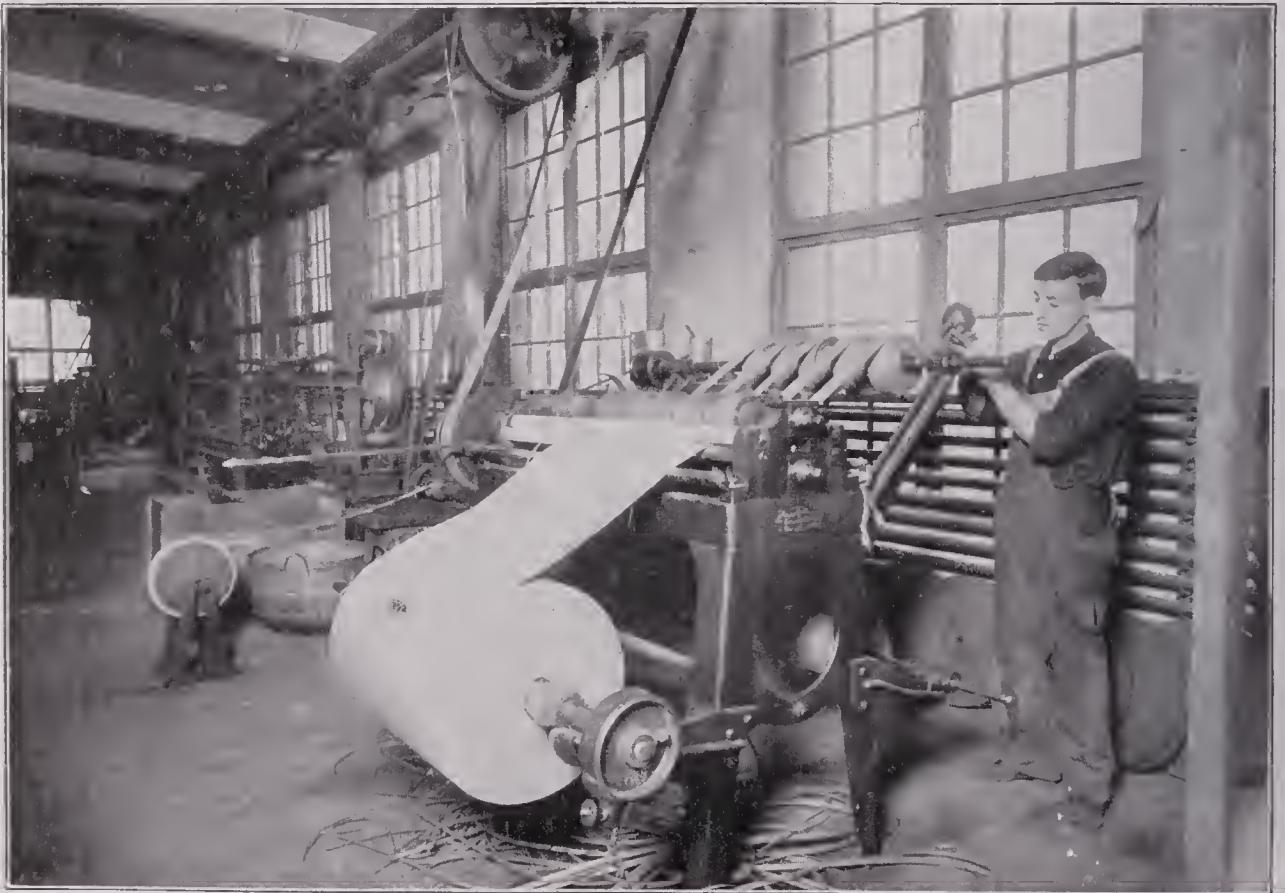
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Here is a dipping machine which holds one million matches. It is officially known as the fastest machine in the world. It takes forty minutes to turn out a million matches.



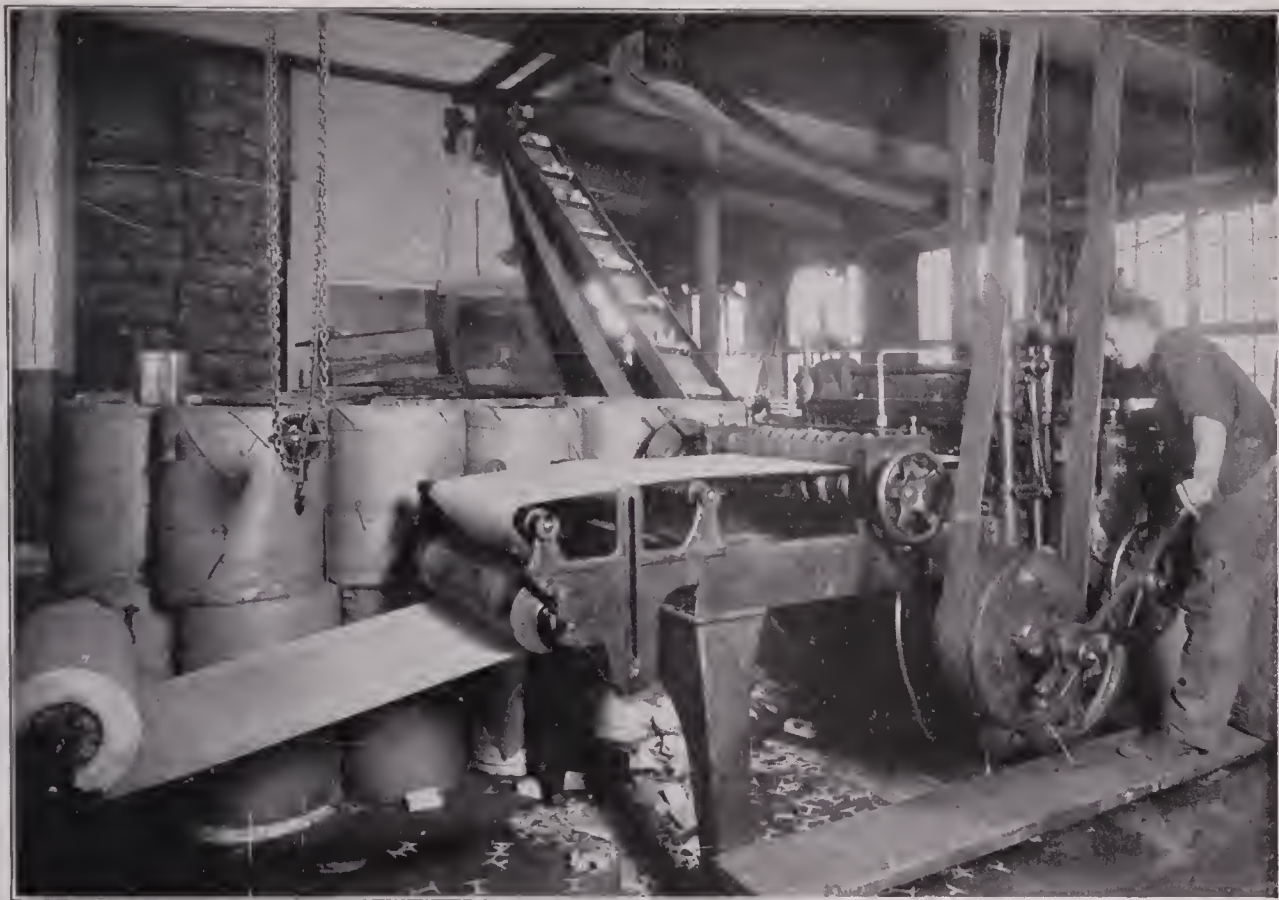
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This picture shows a man taking the trays of completed matches from the belt of the dipping machine. The girl then takes them into the packing room.



Copyright by Brown Bros.

This machine is called a stripping machine. It cuts the paper from which the boxes are made into strips wide enough to make the bottom and sides of a box, or the four sides of a sliding box.



Copyright by Brown Bros.

Here we see a machine for making boxes. This machine turns out sixty thousand boxes per day. The boxes are thrown by the machine upon a conveyer which carries them onto a chute. The chute leads to the floor below.



Copyright by Brown Bros.

This is a machine which makes the book form matches. It turns out four hundred per minute.



Copyright by Brown Bros.

This is the most modern machine for making small size boxes. The machine prints the name, glues, folds and sands the box. This machine can turn out five hundred boxes per minute.



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Here we have a view of the packing room. The matches are packed in boxes, and these boxes are packed by the dozen or gross into larger boxes. Every day sixty thousand packages are packed in this room and made ready for shipment.

GLASS MAKING

VII. A LOOK THROUGH A WINDOW INTO ONE OF NATURE'S WORKSHOPS

When you make taffy, you drop a spoonful of the boiling mixture into a glass of cold water to find out when it is just right to pull. Wouldn't it surprise you to learn that the glass itself was made in much the same way as you make taffy? First the materials are boiled together until the mixture is just right to pour into moulds, or to be stretched into bubbles or rolled into plates.

This seems strange of anything as hard and brittle as glass, doesn't it? But, in the great world of things that men make, it seems to be much as it is in the world that nature makes. There are only a few ways of doing things. The man who invented the spinning frame for making cotton yarn got the idea in an iron rolling mill. And there are only a few things to make everything out of. These are the elements of the earth, the air and water. So when we speak of men *making* things, we do not really mean what we say. All men can do is to take the things that are already made and combine them in new ways, or make new uses of them. Very, very often they merely *find* things that never were hidden.

Glass is one of the things that was found. No one knows just where or how it was found first. But very likely it was in Egypt, where the soil is mostly sand. You have noticed how sand shines, how it glares under the sun. Glass and glaze and glare all mean much the same thing. Now, in Egypt, straw stacks were often burned. In the ashes lumps of glass were found. If you were to find a lump of glass in ashes today, you would naturally think it a bottle that had been melted in the fire. But in old Egypt there were no bottles, no manufactured glass at all. The straw stacks of Egypt stood on sandy soil. Sand melted alone does not make glass, but when mixed with soda it does. There is soda, or potash, in ashes. The ashes of the straw, fused with the sand, very likely, and hardened into lumps of glass. And, besides, there is some glass, or silica, in straw itself, and in many other plants. Did you ever cut your hand on the sharp,

glassy edge of a grass-blade? It is just possible that the straw itself furnished all the materials for the lumps of glass. All that was needed was a hot enough fire to melt them together.

The finding of glass where straw had been burned, set those wide-awake Egyptians to thinking and experimenting. They learned to mix sand with ashes, melt them together, and mould, roll and blow glass into various shapes when it was soft and hot. Our word "soda," is the name the early Italian glass makers gave to ashes. "Soda" really means solid. Today, by soda, we mean an alkali. But soda still has that old meaning of soldering or solidifying. It was the soda that fused the sand into a solid mass.

If one of your window panes could tell the story of its birth in a fiery furnace it would say something like this: "I have some of the same things in me as you have. Two of them are silica and lime. You have silica in your glossy (glassy) hair, and lime in your bones. Pure white sand is nearly all silica. And I was made with heat. You couldn't live unless you were made warm either. I needed more heat than you, that's all. You use sunshine. I used dead and gone sunshine—coal. As the plant is made up of little cells that the sun acts upon, so every grain of sand in me was acted upon by the fire.

"The heat made the little silica cells in the sand fly apart, and it separated all the other things that are in the sand from them. Then the silica particles flowed together again. 'Birds of a feather flock together,' you know. Iron particles flock together when the iron ore is melted. So do gold and silver and silica, or glass. The particles in the sand that are not glass go off by themselves. Where do you suppose they go?

"They just evaporate or disappear in gas. They are attacked by the soda. Soda, lye, potash, or some other alkali does something of the same sort to fats and oils in making soap. It breaks up the fat and eats particles that are not soap. Lime is the purifier, making impurities float to the top. You purify your house with lime. Heat helps, too, as it helps soda and sour milk make a gas to raise mama's biscuits in the oven."

Clean, white sand, soda and lime are put into enormous pots of fireclay in very hot furnaces. Some broken glass is added. For seed? Perhaps. It may be that the bits of glass, having been through the process before, are able to show the way to the raw materials. In making the big clay pots pieces of old pots are mixed with the

GLASSMAKERS AT THEIR WORK



The man on the left has just been gathering glass from one of the huge furnaces. The next man is blowing the glass for a French coffee pot. The one next is cutting glass. He holds it against a wheel, kept wet by water dropping through that tube.



Here we are in the yard of a glass bottle factory. That heap of broken bottles will be made into new ones. The white substance in the bin is soda, which is used to make the glass melt faster in the furnace.



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Here is a man at work at a small fuel oil furnace at which globes or bottles are re-heated previous to finishing. The next picture shows a workman finishing a fish globe which has been previously heated at the furnace.

GLASSMAKERS AT THEIR WORK



On the left are two of the huge pots which set inside of the furnace. In them the glass is melted. On right is a workman preparing glass for being drawn out into tubes.



This illustration shows how glass tubes are made by drawing the molten glass, as you would pull taffy candy.



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This man is shaping and cooling a glass bottle by turning it on a stone table called a "mart." When ready for shipment bottles are placed in frames as shown in this next picture.

raw clay. And scrap iron is added to pig iron. Dear, dear, who would think it. "Come on, all of you, I know the way," the broken bottles seem to say to the sand, lime and soda. So they all melt and run together. Whisk! A lot of matter out of place goes away into gas and leaves a thick, taffy-like, crystal paste in the pot, with some worthless skimmings on top brought up by the lime. You know how you have to skim the dirt and foam that boils up on taffy and jelly? So you do on glass and iron.

This is the first part of making all glass. Next comes the blower. He is a big, sweaty man with a pair of lungs like a blacksmith's bellows. His only tool is a six foot long, hollow iron pipe to blow bubbles with. It is just the stem of a pipe, really, for it has no bowl. He heats the end of the pipe in the furnace, then dips it into the hot glassy paste, and turns it around until he has gathered a lump as big as a goose egg. He swings this in the air to cool it a little, then dips it in to take up some more glass. A third time he does this. He now has a lump as big as a small melon, and that weighs eight or ten pounds. You know glass is very dense and heavy, like iron.

He cools the glass a little more in a water bath. Then he rolls it on a polished iron table to the shape of a little Hubbard squash or big pear. It is still very hot and soft when he begins to blow his big glass bubble. He stands on the edge of a pit to blow, for the weight drags the bubble out long, and his breath stretches it wide. As the bubble becomes thinner it cools more rapidly. So he takes it to the furnace to heat and soften it several times, until it is blown as thin as a pane of window glass.

At this stage he cuts off the neck of the bubble and the end, making a big cylinder, or open glass drum that he catches on his pipe and warms in an oven. The warm, soft glass cylinder is rested on a table, split from end to end with a diamond glass cutter and carried to another oven. Then, when soft, it is ironed out into a flat sheet. The sheet is tempered, or heated and cooled slowly, ironed and polished and cut into window glass for shipping.

Bottles are made by blowing small lumps of glass into iron or brass two-part moulds. Plate glass for show windows, and thick mirrors, is rolled. Liquid glass of fine quality, with no flaws or bubbles or color, is poured from the melting pots onto perfectly smooth steel tables and rolled with steel rollers into sheets, as your mother rolls pie-crust. It is so heavy that the pots are lifted and tipped by cranes, and the tables are carried on wheels to tempering ovens.

Two plates are rubbed together to polish them, and the polishing is finished by hand.

Flint glass, from which microscopes, spectacles and cut glass is made, is the finest of all. It must be as clear as water. This is moulded into "blanks," just the shape that is wanted. Then the patterns are cut on them with iron wheels, or "grindstones," on which water drips. A second and a third wheel are used to deepen the cuts and to polish them. The last wheel is of wood, covered with a soft powder, to give the cuttings a diamond brilliancy. It is all this work, and the danger of breaking in cutting and shipping, that makes our beautiful cut glass so costly.

The most costly of all is colored art glass for church windows, lamp shades and vases. The glass is first made clear white. Then it is painted with metal oxides (rust). The metals are reduced to powder with acids, as iron is rusted by the oxygen of the air. After painting, the glass is heated, melting the metal oxides all through it. So you see, when glass must be clear, as in spectacles and microscopes, cut glass and mirrors, no metals must be left in. Sands with metals can be used for cheap bottles, and these are often green or brown. In the fine stained, or art glass, the metals are broken up and painted on very carefully.

It is a curious thing that, although window glass is among the commonest and cheapest kinds made today, it is more difficult in some ways to make. Long after art glass was made, windows had still to be fitted with plates of mica, such as we use for the little windows in base burners. It was mica, no doubt, of which the apostle wrote: "We now see as through a glass, darkly." It was not until the thirteenth century that plate glass was made. But ancient glass makers made bottles, cups, beads, dice, chessmen, hairpins, pillars for theaters and palaces with lamps inside of them, and even glass coffins.

The Egyptians seem to have made glass first. The Phoenicians learned the art of them and passed it on to the Greeks. The Romans learned it next, but the city of Venice raised glass making from a useful to a fine art. Venetian glass today is one of the art wonders of the world. Next a ruby glass was made in Bohemia.

Some of the great museums are proud of their historical collections of glass, with examples centuries and centuries old. They furnish chapters in the history of the world more important than jointed and chain armor, battle axes and swords. Over against the

wars that destroyed lives and property were these conquests of peace. In the darkest, blood-stained ages, men were conquering the stubborn secrets of nature and building things of use and beauty.

Did you know that *we* have added a chapter to the story of glass? We excel the world in glass cutting, and now we are making Tiffany art glass. It is quite unlike any art glass ever made before. It is used in church windows, lamp shades, and in many useful and ornamental forms. Some of it has all the colors and the airy, fragile grace of soap bubbles, as if deep sea shells and pearls were made transparent and luminous. To see it makes an American proud, for people who can make such a lovely thing have a place in the age-old procession of art, with Greek sculptures and Italian paintings.

RICE GROWING

VIII. THE BREAD OF NOGI, WUNG FOO AND MANUELO

If you should ever go to Japan, one of the very first things you would want to buy is a fat little image that is to be found in all the curio shops. It will remind you of Billikens, the comical little "god of things as they ought to be." A jolly fellow is this Japanese Dai Goku. He always sits like a well-fed miller on a pile of grain bags. If you cannot remember his name, just try asking for Oryza San. That means Honorable Mr. Rice God. Dai Goku is the deity of good fortune who brings big rice crops, and gives everybody plenty to eat. No wonder he is popular. His image is in thousands of low, thatch-roofed, wooden houses, in the farm villages of Japan.

The Japanese are such hard workers, and such wonderfully clever farmers, that Dai Goku really cannot have much to do but sit in a little niche and grin, and make the toilers feel cheerful. But that helps wonderfully. "A merry heart goes all the day," you know. In Japan, the day begins early and ends late, and everybody but much-beloved, honorable grandmother and the baby-who-never-cries, has to work. From every farm village a procession of men, women and children marches to the rice fields at dawn. They all wear single, short garments of blue cotton, and butter-bowl shaped straw hats, as big as a little girl's Sunday parasol. Their legs are bare to the knees, for rice is a flood crop, and they have to slop around in mud and water all day.

In swamps? No, indeed. Rice doesn't like sour marsh land that is *always* flooded. Japanese rice farms are just as likely as not to be perched up on a steep mountain slope. Japan is nearly all rough country, with deep valleys and high mountains. But so many millions of people are crowded into the country, that every little bit of good land has to be made use of. Fortunately there is plenty of water. Hundreds of sparkling brooks tumble and foam down the rocks, bringing good soil with them. The Japanese dam these streams high up, and lead the water down through ditches that wind from one little farm to another, and drop from level to level. They cut the slopes, too, into broad shelves or terraces, and bank



PLOWING RICE LAND WITH WATER BUFFALO.



NATIVES IN PHILIPPINES WINNOWING RICE BY HAND.



A SHEAF OF RICE.

the one and two acre farms with earth to hold the water. Many a mountain slope glitters with flower and grass rimmed rice-ponds, as if set with silver mirrors. Wouldn't you like to see such pretty water farms?

The rice plants are started in forcing beds in the village. While they are sprouting the fields are broken up with mattocks or spades, smoothed over and flooded with water. Into such fields a whole village of families wade. They poke holes in the mud with sticks or their fingers, and set the plants in rows a foot or eighteen inches apart, and clear under the water. In a few days the grass-like green blades shoot up into the sunlight. Each root spreads and sends up several stalks, so the field is covered and looks not unlike a field of young oats, except for the glimmer of water among the stems. When well started the water is let out into the ditches, the field is weeded, the soil loosened and the water turned on again. Flooding and weeding alternate, until the straw begins to turn yellow. Then the water is drained away, and the crop ripens in the sun.

The rice is cut, straw by straw, with a hand sickle. It is threshed by pulling the heads through a saw-toothed frame. It is beaten with flails to free the husks, and cleaned of the tight-fitting brown skin in rude hand mills. Only the rice that is to be sold in the cities is sent to mills to be cleaned between millstones, and polished on skin-covered rollers into shining white grains.

Rice is the bread of hundreds of millions of yellow and brown people. If you could see how hard they all work, in countless tiny fields, in wet, hot lands, you would be glad if they all had a Dai Goku to help and to cheer them. They have no big, strong horses as we have in our wheat fields, no sulky plows and harrows and reapers, on which the workers can ride comfortably, no steam threshers and mills. Most of them work with the rudest tools, and with their bare hands. Some have clumsy, slow animals. In Japan are shaggy, pack ponies shod with rice-straw pads of shoes; and now and then a little wooden-wheeled cart is seen, but the drivers have to walk. In northern China, donkeys are used for pack horses. In southern China, Burma and the Philippine Islands are water buffaloes for plowing, dragging solid-wheeled carts, and working treadmill pumps. But oh, if you could see the big crops that are raised—an acre or two growing food for a family for a whole year—you would think we might learn a great deal about scientific farming from people who can seldom read or write.

In China, the rice fields are in the flood lands along the big rivers. There, it is often a question of keeping the water out when it is not wanted. So banks have to be built, and treadmill pumps used. And the rivers themselves, filled with water as thick and brown as bean soup, are dredged with baskets to bring up the rich soil to spread on the fields. Tens of thousands of men work these treadmills and dredging baskets by hand. Men are even hitched to rude, wooden plows. Blind-folded water buffaloes walk patiently around and around the pumps. As in Japan, nothing is wasted. Straw is cut off at the roots. It is woven into hats and sandals, matting and bagging. Roots are carefully burned and the ashes scattered to fertilize the fields.

In Burma, the banks of the Irawadi River is one long rice field. Water buffalo drag wooden plows and log harrows. Women and children punch holes in the mud with their fingers and set the plants. There "every one works but father." He sits on a flowery bank and smokes and sees that his family keeps busy. The grain is threshed by the water buffalo that trample it on hard ground. In India, the swarming people are terribly poor. They scratch the earth to dust with pointed sticks, weed and flood the land, cut the grain with sickles or little knives, pound the husks off in wooden mortars and do every part of the work by hand.

If you look in a big Geography you can find all these countries—Japan, China, India, Burma, Siam and Malay peninsula in a big continent called Asia. The hundreds of millions of people who live in these countries are mostly yellow. Some are white, and down in Malay they are brown. Rice is the bread of all of these people. And trailing out into the sea, from Malay and Japan, are hundreds and thousands of big and little islands where chiefly brown people live. Our Philippine Islands are among them, and they alone have ten million people. In all these lands and sea islands, rice is grown in much the same way, by the hardest hand labor. In Java the small brown people put little temples, like pigeon houses, in the rice fields, in honor of a goddess who blesses their labor. To these temples they bring gifts of food—sugar cane, ripe fruit and bowls of boiled rice to keep her in a good temper. For oh, they all know that they may work hard, and still the wind and rain and sun may go wrong, and the crop fail. Then they are poor indeed!

But in many of these warm islands, there are bananas and pineapples and cocoanuts, and other good things to eat growing wild,

and fish in the sea for the catching, and bamboo and palms for building houses and boats and nets, so the rice crop is not of such tragic importance as it is in parts of Japan, China and India. In the Philippines the growing of rice is not made so much of a task. Few families grow more than is needed for their own use. Every family has a humpy, horny, pig-skinned water buffalo, to drag the plow and pull the cart. Lazy brown children sprawl on the flowery banks around the fields and watch the clumsy cow struggle in the mud. Each cow has a friendly crow or crane on her back to catch the flies that annoy her, so she doesn't trouble to switch her tail. Brown women in big straw hats, red calico skirts and white cotton jackets put in the plants, weed them and cut the grain with sickles. The buffaloes tread out the grain. And it is a daily "chore" for the children to pound hulls from rice in wooden troughs, and toss the grains in baskets to let the chaff blow away.

In the southern part of the United States rice is grown, too. From Carolina to Texas along warm gulf shores are many stretches of rice fields. But how differently they are worked. The fields are large, and they are owned by white men. They are cultivated by negro laborers who are paid good wages; and oxen, mules and fine machinery are used. The seeds are sown in deep, water-filled trenches a foot and a half apart. The entire field is flooded after planting. Everything is done with machinery and animals—plowing, reaping, threshing, hauling, milling and shipping to the nearest seaport.

It is this Carolina rice that you eat—the long, pearly white grains that make such good puddings, or that is served for a breakfast cereal with sugar and milk, or in the place of potatoes with stewed chicken. Really, as a food, rice is more like potatoes than wheat. It is three-fourths starch. In the brown skin, that is polished away for us, is a small amount of gluten, not one-third as much as there is in wheat. Fortunately, the poor people who live on rice cannot throw away this good brown skin. They have no milk or meat gravy to add to it. In the warmer islands sugar cane is grown, and brown sugar is cheap. But in China and Japan the poorest people feel very lucky if they have a little weak tea to drink, and some dry salt fish to cook with their rice.

We have several names for wheat—wheat when it is in the field and in the threshed grain, flour when it is ground, and bread when it is baked. Many rice-eating people have five names for their chief food—one in the field, one when cut, one when threshed, one when

milled (paddy), a fourth name when polished white, and a final name when it is cooked. It is cooked in only one way—plain boiled or steamed, whether it is meant for the table of the Emperor or for a peasant. But there are as many varieties of rice as there are of apples. There is cheap, dark, small-grained “coolie” rice, and big, fat, white “mandarin” rice. The finest rice of all, like the finest tea, is used by the royal family.

Thousands of years ago the Emperor of China used to head a splendid procession, and sow the first rice seeds of the season in the palace water fields. That ceremony was supposed to insure good crops to the toiling millions. Perhaps that was the origin of the little good-luck god, Dai Goku, of Japan. He certainly looks very old and wise and kind. See RICE, page 1610.

WATCHES AND CLOCKS

IX. BROWNIE TICK-TOCK AND THE STARS

It's great fun to hold a watch up to a baby's pink ear. He is so as-ton-ished by the busy tick-tick-ticking. One little girl remembers thinking a Brownie did the ticking, and that the mouse that ran up the clock did the striking. When the little gold back doors were snapped open, she fully expected to see a live playmate pop out. Before any child can talk plain he wants to know what makes the wheels go 'round.

Once there were only clocks, and clocks without ticks, at that. A clock without a tick seems as odd as the smile without a cat in Alice in Wonderland. In pictures, Old Father Time carries an hour-glass clock. In an hour-glass it takes just one hour for the sand to run through a little hole from one hollow glass cone to another. It is wound up by turning it over at the end of every hour. Really, Father Time ought to carry the sun, or a bunch of fire-cracker stars. They are the oldest and best timekeepers.

If you were to stand still, all day, in a sunny field, and watch your shadow grow shorter, up to noon, then jump around to the other side and grow longer until sunset, you might think of making a shadow clock, or sun-dial. A sunbeam, shining through a hole in a roof, makes a moving golden spot on the floor below. If you ever go across the ocean to the old world, you may see stone sun-dials in castle gardens, and clock-faces in the marble floors of great churches. Shadows and sunbeams were the first hour hands.

In old, old times people didn't have to catch trains, nor little children go to school, so minutes were not very important. But they did want to measure the exact length of eclipses of the sun and moon. A little over three hundred years ago, a great astronomer named Galileo was in a church, when some one bumped into a hanging bronze lamp and set it swinging. Back and forth it went, back and forth, as regularly as—guess! The pendulum of a grandfather's clock. When it slowed down and stopped—when “the old cat died,” as you say when you stop swinging, he started it again with a push.

You can make a pendulum with an apple and a string hung from a gas jet. It took another hundred years to fit wheels and weights to pendulums so they could be kept swinging for a whole day and night.

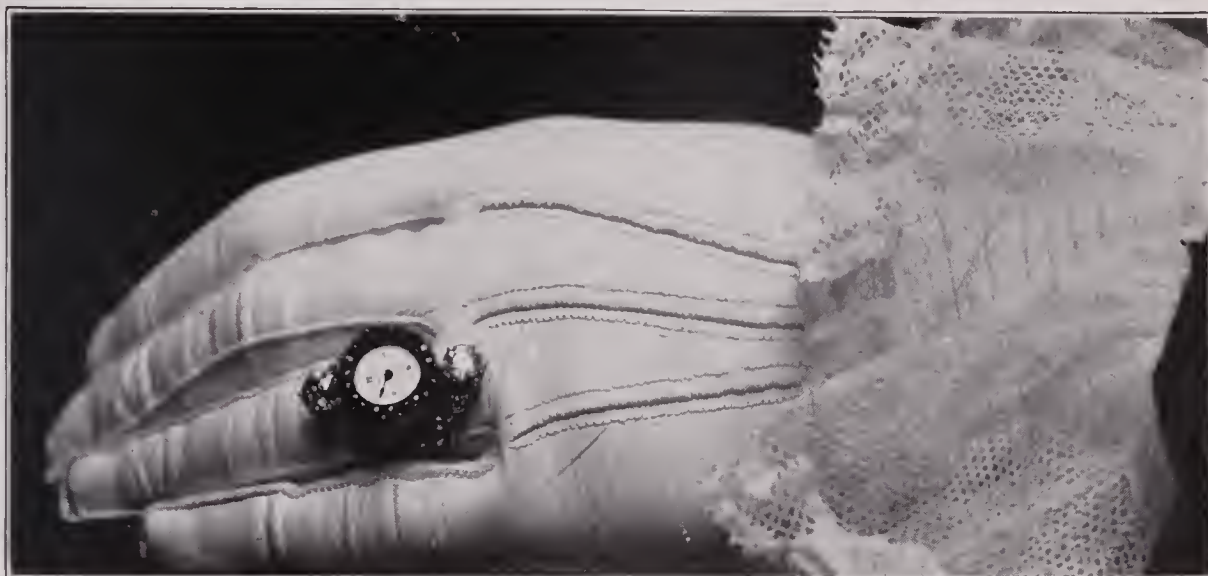
To understand what makes the wheels go 'round in papa's watch, a little boy or girl would better begin with the big grandfather's clock in the hall. What a broad, pleasant, honest face it has. Twelve numbers it has, evenly spaced on a circle, like the old stone sundials, and two hands moving around to point the hours and minutes. On the lower side is a small dial with a tiny hand racing around it and counting the seconds. The hour and minute hand are fastened to axles that are pushed through a hole in the middle of the dial. Axles are the centers of wheels, you know, so there are wheels behind the dial. In the face of the clock are two more holes. These are key holes for winding up the weight and the hammer that strikes the hours. A watch has no key holes. It is wound up by the stem.

That is all you can see until you open the tall, narrow door below the face. There, in a sort of closet, the long pendulum swings back and forth, its bright brass "bob" winking in the light. And, at one side, a heavy iron weight hangs on a stout cord. "Tick-tock" is all a clock says to most grown-up people. But to children and poets it says all sorts of things. One thing it says, if you are small enough to squeeze in behind the pendulum, is: "Tick-tock, fennel-and-dock, jump-in-quick and climb-up-the-clock!" If you were a Brownie you could scramble right up the pendulum rod or the weight cord and find the "tick."

But eyes can climb where little boys can't. Look up into that Chinese puzzle of wheels behind the clock dial. The pendulum rod goes up to a sort of beam near the roof. There it is hung by a thin slip of steel that bends easily and makes a spring. It allows the pendulum to swing just so far, and then gives it a little push back. Now look up the weight cord. The cord is ever so long. The upper end of it is wound around a drum or barrel, very much as the rope of an old oaken bucket is wound on a windlass. The weight pulls on the cord and barrel all the time, but it cannot move them until the pendulum is set swinging. Start the pendulum and see what happens. The whole clock wakes up, like the palace in Sleeping Beauty.

The pendulum lifts one leg of an anchor-shaped piece of metal that is locked in the saw-teeth of a wheel. When this wheel is

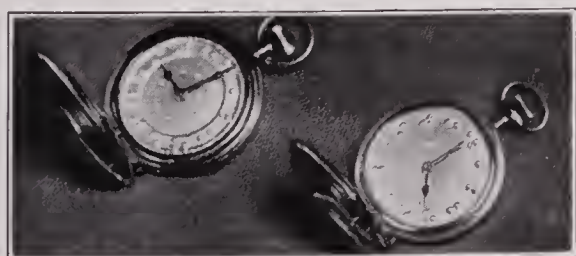
SKILLED WORK IN TIMEPIECES



THINK OF PUTTING ALL THE PARTS SHOWN IN THE NEXT PICTURE IN THIS "BABY" WATCH FOR A LADY'S RING. THE WATCH HERE SHOWN IS SET BETWEEN A RUBY AND A DIAMOND AND IS WORN OUTSIDE THE GLOVE. IT KEEPS PERFECT TIME.



These are not quite all the parts of a watch, all of which are contained in the one shown in the lady's ring. And remember that every part must be perfect. Imagine the skill required in making these parts in the first place and then in putting them together. No wonder the watchmaker must work with a microscope in his eye!



With the watches on the left you could tell time in the dark. They are made for the blind. The figures on the dial are raised dots, one for every hour. On the right is a group of clocks in a jeweler's window in Berlin that give, all at once, the time in Berlin, Paris, St. Petersburg, London, New York, San Francisco, Pekin and Tokio.

unlocked it turns a little. This allows the barrel to turn. The cord and weight pull on the barrel, too, to help it turn. And this sets all the other wheels in motion. You didn't know that all the wheels in a clock are called a "train of wheels" did you? They are all coupled together, just as a train of cars are, and travel together. The pendulum seems to be the engineer; the locked wheel is the throttle; the barrel, cord and weight are the engine, furnishing the power to pull the train. The locked wheel is a safety valve, too, as well as a throttle.

The little saw-toothed wheel and the anchor, or lever catch, are there to tell all the other wheels not to go too fast. Every time the pendulum swings, a tooth of this wheel is let go. Then another tooth is caught and held an instant. This catching and letting go make the clicking or ticking sound in watches, and the solemn tick-tock of big clocks. The wheel and the catch are called the "escapement," because the wheel turns around, or escapes, only one tooth at a time. At every *tick* the escapement says: "Not-so-fast," and at every *tock*, "Go-ahead." You see, when the cord and weight begin to pull on the barrel, it would whirl over and over, as fast as it could, if nothing held it back. Then all the wheels would fairly race, until the weight had dropped to the bottom. There would be a grand smash-up, if the escapement wasn't there to hold them all to a steady gait.

The whole duty of a good clock is to drive the hour hand at a regular rate of travel around the dial, twice in twenty-four hours. So the barrel turns entirely over twice, letting down two coils of cord. In an eight-day clock the cord is wound around the barrel sixteen times. On the rear end of the barrel is fixed the hour wheel. Both turn together. The minute wheel and the second wheel are fitted there, too. All of these turn on other wheels and pinions. The axles of the pinions are extended and pushed through the dial to carry the hour, minute and second hands. So these hands just have to turn when the wheels turn.

Sometimes a clock goes too fast or too slow, and must be regulated. A grandfather's, or other pendulum clock, is regulated by pushing the "bob" of the pendulum up or down on the rod. The time it takes a pendulum to swing, depends upon the length of the rod. In a watch, or a spring clock, there is a key-stone shaped indicator plate right over the coiled spring. One side is marked S (slow) and the other F (fast). A movable pin over this plate regulates

the swing of a fussy little wheel that rocks back and forth like a cradle.

Of course you have guessed that this rocking wheel in the watch is really the pendulum wheel. There is no room in a watch for a long pendulum rod and "bob" to swing. And there is no room for a cord and weight and big barrel to furnish power. The "engine" of a watch is a blue-steel coiled spring. The escapement, or little saw-toothed wheel and catch, is in the watch, just as it is in the clock. Ask your papa to open his watch at the back. Over these parts the plate is cut away, so you can find all of them.

Ask your papa to keep the back door of his watch open while he winds it up by the stem. Then you can see the loose, open coils of the main spring come closer together, so the spring fills less space. A clock is wound with a key that slips through a key-hole, over the axle of the barrel, in the dial face. The key winds the spring in a spring clock, or winds the cord around the barrel in a pendulum clock. The other key-hole in the clock face is to wind up the wheel that controls the striker. At the end of every hour, the hammer connected with this wheel is lifted to strike a bell, from one to twelve times. To put a wheel, a spring and hammer and a bell in so a clock could do its own striking, was a wonderful improvement. Once a town or a church had to keep a man to pull a bell rope, to make the big clock in the tower strike the hours.

A watch is the most wonderful little machine in the world. Packed away in mama's watch, that is no bigger around than a silver quarter and less than half an inch thick, are one hundred and fifty or more separate parts. There are wheels of many sizes and shapes, pinions, plates, screws, rivets, pins, springs and "jewels." Many of these parts are so small that watch-makers pick them up with tweezers or magnets, and find the places for them by screwing a magnifying glass in one eye. Wouldn't you like to go through a watch factory and see all these parts made and put together?

The first things you see in a watch factory are spinning wheels—little whirling tables no bigger than the head of mama's sewing machine. There are rows and rows of them, connected by belts with flying pulley wheels overhead, and operated by men and women. These machines are lathes. Lathes are used for shaping round things in metal as well as in wood and clay. Here the lathes cut teeth on little brass wheels and threads on the outside of screws and the inside of screw-holes.

First, the round blanks for wheels are cut from strips of sheet brass. A brass ribbon as wide as the wheel is fed into a machine. A steam hammer with a die on the end as round and sharp-edged as a cookie cutter, comes down and cuts out little brass "cookies" that look like very thin, bright, telephone slugs.

Watch wheels all have holes in the middle like some cookies, and teeth or scallops around the edges. The hole is drilled first, and a number of blanks are strung on a rod like flat beads on a string. Then the rod is clamped into a lathe. The operator slips a belt over the wheel—whir-r-r, how it hums! A steel chisel cuts a row of teeth up and down in all the blanks at once. Click, the rod turns a little and another tooth is cut.

A screw-making lathe clips a tiny bit of brass wire from a coil, whirls it under a chisel to point one end, strikes a blow that flattens the other end into a head, and saws a slot across the head for the screwdriver. Then a fairy chisel cuts a thread-like spiral groove from near the head down to the tapering tip. When it is done it isn't much bigger than a little brown seed. Hundreds of them can be put into a pill box, or a one-ounce bottle.

In a watch factory are big fire-clay ovens, or kilns, as there are in potteries, for baking—what do you suppose? The white china dials. Some dials are gilded or plated with gold, but most of them are enamelled on copper plates with fine white porcelain from the pottery. The wet clay paste, or dough, is spread on the dial plate, baked in the oven, ground down smooth and glazed. When they come out of the oven they shine like frosted cakes. A pattern printed on a fine transfer paper is laid carefully on the dial and pasted smooth. Into the oven it goes again. The paper is burned up but the pattern is burned in. The dial of papa's watch and your pretty china breakfast cup are decorated in much the same way.

The most delicate parts of a watch are the springs—the main-spring and the hair-spring. They are tiny ribbons and hairs of blue steel, so flexible that they can be coiled up tight, but so strong they can pull the wheels along. They are made of steel wire, ironed or rolled out flat, tempered by heat and cold, "blued," and with rivet holes bored in the ends. In a watch you can see the main spring beat and throb like a little live heart.

Machines make all the parts of a watch more perfectly and hundreds of times faster than men could make them by hand. But no machine can put all the parts of a watch together. A skilled

watchmaker, with a magnifying glass screwed into one eye, has to pick up the one hundred and fifty separate parts, some with magnets, and fit them all together into a compact circle that will slip right into a tiny gold shell of a case. And he has to do all this so the little machine will keep perfect time. No spring must be too short or too long, no screw too tight, no wheel or tooth must rub another.

. When your watch runs down you ask someone the time, or you set it by a public clock. In watch factories every watch is set and regulated by the fixed stars. The sun is not the best time-keeper. It goes fast or slow, or it seems to do so. But the earth turns around and around in the same space of time, day after day. As it turns, certain fixed stars, or very distant suns that appear as stars, come into view at the same instant each night. In a big watch factory an astronomer has a telescope set so that these stars seem to pass across the lens. Really, watches are set by the earth we live upon. The hour-hand of a perfectly-timed watch goes twice around the dial in exactly the same time that it takes our dear old earth to turn over once on its axis. The heart of the big earth and the heart of the little watch beat together.

Isn't that very wonderful? And don't you think Old Father Time ought to carry a little bunch of stars?

GOOD HEALTH

EDITORS' NOTE TO MOTHER AND TEACHER.—Do you remember the first time you opened the old-fashioned text-book on "Anatomy, Physiology and Hygiene?" It began by enumerating the two hundred and eight bones of the human body, and showed them all in a cheerful picture of a skeleton. A year's study left you with a dazed sense of how fearfully and wonderfully you were made. But much of the knowledge was unpleasant and seemed of no practical use. The "Hygiene," or instructions on how to keep the body in health, was vague as to detail and was given little space in the back of the book next the index. Wasn't this absurd?

Nowadays, in all lines of education, we are letting the horse pull the cart. In the very first year of school, in simple, good health talks, little children are told how to take care of the dear, rosy bodies they live in, so they can enjoy playing and working, eating and sleeping, and grow up into fine, strong men and women. Good health, you see, is a habit, and habits must be caught young. Little tots can understand why they should stand and sit straight, to give lung-bellows and engine-heart room; why they should breathe pure air, deep, and sleep with the window open; why they should bathe often, and keep the teeth clean, and not read by dim light, or sit with wet feet and clothing. They can understand why they should eat a variety of food, slowly, and not overload the stomach, or never give the little food-mill a rest.

Regard for personal health leads naturally into regard for the family and public health, and those are domestic sanitation, sociology and civics. Big words and big ideas for little folks, you think. But are they? We are all bound together. None of us can live alone, or be unaffected by the people and conditions around us. Any little child who "catches" the measles can understand the need of quarantine. Domestic sanitation is just good health housekeeping, and practical civics for most of us is just good public housekeeping. The health, street-cleaning, police and fire departments exist to protect the health, lives and property of all the people. They all come very close to our daily lives and concern us all. We can help in this public housekeeping, take a part in the government. If we fail to do so, are selfish, indifferent or lazy, we must suffer for it.

It is astonishing how very early little children can be made to understand these things, and be brought into active relation with government; with a sense of duty toward the general public, and respect for the blessings of health, law and order in the community. In some large cities, school children are organized into brigades to help the officers keep clean alleys, and clear fire escapes. Little soldiers of peace they are, serving their country as patriotically as heroes of war. The schools understand now that children need education and experience in intelligent citizenship, as much as in arithmetic.

GOOD HEALTH

I. YOUR OWN HEALTH

You live in a little house all by yourself. You were born in it. You will have to live in it all your life. It is your body. People who own houses are proud of them. They take care of them, and try to live in them just as comfortably as they can. The first thing necessary to live comfortably anywhere, is to keep everything sweet and clean and in order.

Your body has a framework of bones, as a house has of timbers. The muscles cover these bones as weather boards, lath and plaster cover the timbers. The skin is a sort of coat of paint to protect the house from the weather. Your body has a heart, that is a little heating and pumping plant. It has all the tools in it for preparing food for use in the body. It has lungs for ventilating with fresh air. It has sewer pipes for getting rid of waste, and it has a network of little nerve wires to give warning of trouble, inside and out. It has windows to see through, and a telephone in the ear.

It is much better to use a house than to let it stand idle. Things rust out quicker than they wear out. So it is with your body. You must use every bit of it, every day, and live in every corner of it. The bones and muscles become weak and stiff if they get no exercise. Working muscles and bones call for more blood. This compels the heart to beat faster and stronger, and the lungs to call for more air to keep the blood purified. All parts of the body should be exercised equally. Swimming, rowing, skating, bicycle riding, dancing, and just plain walking in the fresh air, are splendid exercises. Games, like base-ball, foot-ball, basket-ball and tennis are fine, too. They train both mind and body to think and act quickly. Sweeping a room, hoeing a garden and splitting kindling for mother, are good for the body, too. Laziness is rust for body and mind as well as for the hinges of a door. Don't do anything half-way. Study hard, get your lesson and quit studying. Play hard and then rest.

Next, "don't worry!" You know care killed a cat, and cats are supposed to have nine lives. Don't hurry, or over-work or over-play. Don't lie awake and think about that examination. If you do your best every day you don't need to worry; and if you don't do your best worrying will make it worse. If your brain is to do good work it must have sleep. Eight hours for work, eight for eating and playing and eight for sleep is a good rule for grown people. Children need less work and more play and sleep.

Eat at regular hours, but never eat unless you are hungry. Missing a meal gives an overworked stomach a chance to catch up. It needs rest as well as the muscles and brain. Eat enough at meal times and don't "piece" between meals. It takes several hours to empty a stomach. Don't eat anything "to keep it from spoiling." It is better for food to spoil outside a stomach than inside. Don't make a meal of one kind of food because you like it. A dinner all meat, potatoes and pie is too heavy for anyone but an ostrich. There are several kinds of food. One kind is mostly starch, such as bread potatoes, rice, etc. Then there are fat foods, as butter, cream, oil and fat meats. The third kind is lean meat, beans, eggs and cheese. Besides these we need green vegetables and fruits, for their water, sugar, acids and minerals. They help digest the heavier foods. A mixed diet is best for human beings.

Take time to eat. Chew your food. Many grown people eat as if they had to catch trains. This is a greedy, unpleasant habit. Besides, it is harmful. In chewing, the mouth makes a liquid that the stomach needs for digestion. It is called saliva. Think of sugar and feel the saliva run into your mouth. Swallow it; don't spit it out. Spitting is another bad American habit. It is not only disagreeable for other people to see, but it wastes saliva. If you eat too fast, the mouth hasn't time to make enough of it. Besides, your teeth need exercise. The broad, grinding teeth in the back of the mouth usually decay first. We use them less than we do the front, cutting teeth. Don't overeat. If you fill a furnace too full of coal you smother the fire. Doctors often have to be called to help people digest their Thanksgiving dinners.

When you were rubbing yourself dry, after a bath, did you ever rub little rolls up on your skin? That was dead skin, dust, dried sweat and oil. An air-tight coating soon forms on the outside of the skin. Warm water, soap and scrubbing with a brush remove it. If not removed it injures your health and your

appearance, and it gives you an odor that is unpleasant to other people.

To keep really clean and the skin healthy, a warm, full bath with soap and flesh brush should be taken twice a week. The hands and face are outside in all weathers, all the time, so you must get into the nooks and corners of ears, nose, knuckles and finger nails every day. The teeth must be brushed with powder after every meal, and the mouth rinsed. In a warm, moist mouth bits of food quickly decay. You cannot keep your little food grinders and cutters for seventy years unless you take care of them. Your hair must be shampooed as often as every ten days or two weeks. Hair collects dust and oil and perspiration, and dead skin on the scalp, too.

The morning shower or plunge bath in cool water, and a brisk rubbing with a coarse towel, brings the blood to the skin and makes you feel warm and bright and active. It makes you feel sudden changes of temperature less, so you do not "take cold" so easily. Don't forget the inside bath. Drink a lot of cool, pure water. Drink four to six glasses a day, and more as you grow older. Water washes through all the waste pipes of the body and cleans them. It is best to drink between meals, before breakfast and at bed-time. Water at meal times dilutes the food in the stomach too much.

When they are filled with air, the lungs expand two inches or more. This is a sign that clothing should not be too tight. The lungs go down almost to the waist line. You should breathe deep as well as wide. You cannot do that if you wear a tight belt. Clothing should be warm enough for the weather, but not so heavy that it tires you to carry it. The weight should hang from the shoulders, not from the hips. The shoulders were made to carry burdens. Weight on the hips and waist presses down the stomach, and all the organs below it. Don't wear shoes in which you cannot wriggle your toes. Shoes for children should have straight, broad soles and low or spring heels.

Don't be afraid of fresh air. Use it all the time. There is plenty of it and it costs nothing. You wouldn't want to wear a suit of second-hand clothing, would you? Your lungs do not like to breathe second-hand air. They need the oxygen that is in fresh air. (See AIR.) A great many people seem to be afraid of night air. That is all the kind of air there is at night, so you have to take your choice between fresh night air and used night air. Doctors cure people with sick lungs by having them sleep out of doors. You can keep

your lungs well by siceping with the windows wide open. Use plenty of bed clothes to keep warm. If your head is cold don't pull the bed clothes over it and breathe the same air over and over. Wear a flannel night cap.

Fresh air never made anyone "catch cold." But impure air, living in houses that are too warm and close, sitting in drafts when overheated, and sitting with wet clothing and feet, will often make you catch cold. Keep warm and dry, well-fed, clean, active and cheerful, drink pure water and breathe fresh air, and you will keep well. Don't go where you know there is anything "catching." People used to think all children had to have measles, mumps and whooping cough, and that these diseases were not serious. Now we know they are often serious, and that we may escape them. Scarlet fever and diphtheria are very dangerous. Don't drink from a public drinking cup unless you first wash the cup thoroughly. Finally, don't sit "humped up" in a chair, or at a school desk. Only camels are allowed to have humps.

There are four things that doctors should attend to in children who are otherwise in good health. One is: A dentist should examine the teeth twice a year. Even the "baby" teeth should be kept clean and filled with cement. That will make them last longer, keep the stomach healthier, and make the second teeth stronger and better in every way. That saves money and pain, too. Second, human beings were meant to breathe through the nose. Little boys and girls who go about with their mouths open, do so because they cannot get enough air any other way. Little balls of flesh called ad'en-oids, grow in the air passage back of the nose. They must be taken out, or they will certainly make a great deal of trouble.

If there are singing or buzzing noises in the ears, if the ears ache often or pus runs from them, or you cannot hear what people say to you easily, you should go to a special ear doctor. Often ear troubles in children are easily cured, but if you neglect the trouble you may become very deaf. Your ears are your telephones, so be sure they are in good working order. Often children in school are thought to be stupid when they are only hard of hearing.

Your eyes are the windows of your soul. They should be clear and bright, for you cannot see through dim glass. If print blurs or spots dance before the eyes, if you cannot see without squinting, or know the face of a friend across the street, or if you often have a headache after studying, when you feel well in other ways, you may need

to wear glasses. You can injure good eyes in several ways. You must not read very fine print long, or read by a dim light. The light should fall on the page or the work you are doing, not in your eyes. And it should not dazzle. If your eyes feel tired, rest them by bathing them in cold water, and closing them awhile.

Do not try to "doctor" yourself. Good mothers know a great many things to help little boys and girls over small troubles. But if the trouble is something she doesn't understand, it is best to see a doctor. Don't take patent medicines. If you are so ill that you need medicine you don't know the kind you need, nor how any kind will affect you. And a great many patent medicines have alcohol and dangerous drugs in them.

II. THE FAMILY HEALTH

As each person has to live in his own little body house, so we all have to live with other people, in houses that have been built of wood or stone or brick. Some of these houses are very old, and were built before people knew as much about health rules as we do today. Some are newer, but were badly built. Still, we have to use them. Very few of us will ever be able to build a new house. Few of us have a very wide choice of the house we must live in. It seems more sensible for us to learn how to make the best of whatever house shelters the family.

A family has the best chance to escape sickness when every member of it has good habits of eating, bathing, sleeping, working and playing. Then the house must be kept clean from cellar to roof. The basement should be light and dry and airy. No decaying vegetables or fruits should be left in it, for these poison the air of the living rooms above. It should be built of stone and cement. Once a year the walls should be cleaned and whitewashed. The living rooms should be cleaned twice a year, and the walls calcimined or painted once. If the walls are papered, the paper should be cleaned. New paper should not be put on over old. Hard wood floors, with small rugs, are the best floor covering. Rugs can be taken out of doors often, and the floors washed. Iron or brass beds are cleaner than wood. Window draperies and all bedding should be washable. Carpet sweepers and soft cloths should be used. Brooms and feather dusters scatter dust.

You know you need to drink water to wash out the waste pipes of your body. The waste pipes of houses become foul with decaying matter. They must be flushed every week with enough boiling water and washing soda, or even chloride of lime, to cut all dirt out. This must be done in kitchen sinks, laundry tubs, bath room plumbing and ice boxes. Plumbing should be open, so you can see the pipes. Sunlight and soap are great purifiers, so plumbing should never be boxed in. People are often poisoned by sewer gas or foul air from old, dirty, boxed-in plumbing, or even from new, cheap plumbing. You cannot smell sewer gas and that makes it all the more dangerous. Sometimes the plumbing in a house cannot be made safe. It has to be taken out altogether. In renting a house the

plumbing, the basement, the gas fixtures, the water supply and the heating plant are the really important things. A leak in a roof is a slight matter beside a leak in the plumbing.

Stale food should not be allowed in pantries and ice boxes. Kitchen waste—garbage—should be destroyed every day, or carried away. There should not be a crumb of bread or sugar to coax flies in. Cut bread and other food on newspapers and roll them up. Flies forget to wipe their little feet, and they bring typhoid fever and other diseases into the house. So doors and windows should be screened. Food should be fresh. Flour and many dry foods may be kept for months in dry storerooms. If unfit for use they smell moldy. Meat, butter, eggs and milk warn us of decay through our noses, too. Wilted green vegetables should be crisped in cold water. Fruit that cannot be eaten fresh, should be preserved by cooking.

A family should be sure the drinking water is pure. Spring water is the best and purest of all. In cities, water is supplied to all the people from reservoirs fed by springs or rivers, or from a lake. Sometimes it is necessary to filter or boil the water. Boiled water should be cooled and air put back into it by pouring it from one vessel to another several times. This must be done because boiled water tastes "flat." It is not unhealthful, but people care so little for it that they will not drink enough. Air in water makes it sparkle. Spring water, in gushing out of the ground, takes up a great deal of air.

Heat is the next important thing. You do not want a hot-house. Hot-houses are useful for growing delicate plants. Hot dwelling houses grow delicate people. The temperature of a house should be 68 or 70 degrees by a thermometer hung in the middle of the room. And it should be an even temperature, not 85 for a little while and then 60. So the fireman of the family should study the heating plant. The house may be heated by stoves, or by a hot-air, steam, or hot-water furnace. Different stoves and furnaces take different kinds of fuel, and different ways of managing them to get the best work from them at the least cost. Sometimes badly managed furnaces give off a poisonous gas that makes people ill. If the drafts are used properly, coal gases will go up the chimney.

Once in awhile you read about people being killed while asleep, with gas that escaped from a stove, a furnace, or a gas jet. This could not happen to people who sleep with the windows open, for the gas would go out of doors, but enough might collect in a well-

ventilated house to make sleepers ill. No coal gas should escape from a furnace or stove, and gas pipes and burner keys should be tested often. Don't test them with a match, if you suspect a leak. Your nose is safer and just as reliable. You can always smell escaping gas. If you can't find the leak that way, send for a plumber. The leak may be from a pipe in a wall, or under a floor. A neglected leakage of gas may not only cause sickness, but also an explosion and fire.

Ventilation should be studied. Every house has windows and doors. Most of them have transoms over the doors. A few have fireplaces. Fireplaces are the best ventilators, even when there is no fire in them, for bad air is drawn up the chimney. A window, lowered from the top a few inches in cold weather, lets fresh air in between the sashes, and the bad air out above.

The time we need to be most careful about ventilation is in the winter. On cold winter evenings the family likes to sit in the cosy living room, warmed by the steam radiator or base burner stove. Two or three gas jets burn for reading or sewing. Fire and people use up the oxygen in the air very fast (see AIR) and make carbon dioxide. In an hour or two the oxygen supply in the room gets too low for comfort, and the carbon dioxide too high.

Look for these danger signals: Father begins to yawn. The lights do not burn so bright. Big brother feels dull and can't do his arithmetic. Sweet tempered sister gets cross. The only bright and happy person in the room is the baby on the floor. The baby has the best air of all because warm, used air goes up. But even the baby cries after awhile; the canary bird nearly tumbles off its perch and mother has a headache. The bad air almost fills the room. No one knows what is the matter. It's lucky if some one comes in from outside and says: "My, but it's stuffy in here." A window is opened and everyone brightens.

The next time that happens in your family, test the air in the room. Bring in a small glass jar of water and a bottle of lime water. Pour the water out of the jar and let it stand a few minutes to fill with the air in the room. Then pour a half inch of lime water in the jar and shake it hard to mix the air and water. If there is too much carbon dioxide in the room the water will turn chalky. The remedy is fresh air. Air as bad as that ought to be turned out of doors.

Every family should have a few simple "first aids for the injured" in the house, and know how to use them. A cut, a burn,

a bruise, a bumped head or a bleeding nose, should be attended to without calling a doctor. Slight ailments, too, can be managed. Any family doctor, for the usual office visit fee, will tell you what things to keep on hand and how to use them. Better still, there are little books written by doctors telling "What to Do in Emergencies." Some of them cost only fifty cents, and can be kept in the medicine closet.

A house should be orderly, quiet and cheerful. Mother works hard to keep everything clean and in place. You know it is bad for anyone to overwork. Most families thoughtlessly overwork the mother by throwing things around, and bringing dirt into the house. Perhaps that is why she is cross sometimes. She is not only overworked, she is worried because the work is never done. If it isn't good for you to lie awake and worry over examinations, it isn't good for mother to worry about how much extra work she has to do tomorrow.

Loud noises really hurt many people. Nerves need rest as well as bones and muscles, brains and stomachs. In cities, street cars and railroad trains, factory whistles and wagons and noisy crowds are always hammering at people's nerves. Homes are the places to rest nerves. So don't slam doors or scrape your chair legs on the floor, or throw your shoes across the room, or shout to someone upstairs. You may yell on a hundred-acre farm, or at a baseball game where everyone else is yelling. Very good people often quarrel and cry about little things, because their nerves are tormented all the time. Watch these danger signals. Sick nerves take a long, hard time to cure.

Finally, don't take all your troubles into the house to talk over. Long ago a great poet said: "A merry heart goes all the day, a sad tires in a mile-a." This is just as true as that two times two are four. Laugh and grow fat, and save doctor bills. Laughing exercises the lungs; sour thoughts sour on the stomach. Bring all the cheerful things, the pleasant things, the funny things you come across, into the house. No family is as healthy as it might be unless it is happy.

SOLDIERS OF PEACE

I. FIGHTERS FOR EVERYBODY'S HEALTH

In the story about America's "Front Door" you learned that United States health officers meet every ship that enters an American harbor. If there is one case of yellow fever, smallpox or bubonic plague on board, the ship must wait outside long enough to see if other people on board are affected. The sick person must be removed to a pest-house and the ship disinfected. This is called going into quarantine. If certain dreadful diseases were allowed to come into our country, they might run across it like a prairie fire and cause thousands of people suffering and death. Sometimes our seaports are closed to ships coming from foreign cities where these diseases exist. Rats are known to carry them as well as people, so warfare is waged against wharf rats. Foreign emigrant people are not allowed to come into our country at all if they have tuberculosis, or contagious diseases of the eyes and skin. There are pure food laws to stop unfit food from coming into the country, or from being shipped from one state to another.

The health officers of states take up the work of protecting the people where the government leaves off. A state may quarantine against another state or city, that is, it may refuse to allow trains and boats to come from them if certain contagious diseases become very bad. States compel doctors to report contagious diseases, and make people who have smallpox, scarlet fever, or diphtheria put cards on their houses and obey quarantine laws. Children with measles, mumps, whooping cough and chickenpox cannot go to school. States inspect factories to see that workers are not overcrowded, that guards are put on machines to prevent accidents, that good light and air is supplied, and that children under a certain age are not at work for wages. States have pure food laws, too, to punish people who make or sell unfit food in the state. In one city, not long ago, many barrels of dirty sugar were seized. The sugar was sweepings from sugar refineries. It was sold to candy makers. There

were disease germs in that sugar. Don't you think men who would sell such sugar, and men who would buy and make candy with it should be sent to prison?

In cities, a great deal more has to be done to protect the health of the people. Dirt is a disease breeder. Dirt, you know, is not just black earth. It is matter out of place. Mud is a fine thing in a rice field, but it is dirt on a little boy's face. So, kitchen refuse is garbage in a house, but it is good food in a chicken yard and pig pen. Old boxes and newspapers litter a house, but are fine for kindling fires. Sewage water and stable soil poison people, but make plants in a field grow. Tin cans, old iron, old shoes, rags, bottles and bones can be made over into useful things in factories, and junk men will often give country children bright new pennies for saving them. If they cannot be sold they can be buried and, with ashes, used to fill in holes. On farms, and even in towns, where homes have large lots, each family can use or destroy its waste.

In cities, people have no gardens, or chickens or pigs. Very often they burn gas for cooking, and cannot use up kindling. Bonfires in narrow alleys and on streets are dangerous, and destroy pavements. There must be good public housekeeping to take care of all the waste of all the people, or there would be dirt, disorder and sickness that the cleanest person and the cleanest family could not avoid.

Public housekeeping in cities begins at street gutters and back gates. It is just like family housekeeping on a big scale. A family has a waste paper basket, a slop pail, a rag bag and an ash can, and does not allow members of the family to mix different kinds of waste, or to scatter trash. The streets and alleys are everybody's floor. Everybody has to pay the city a little in taxes to keep the public floor clean, and to carry away, destroy or use the waste. Everyone is expected to help in this work, by following the same sensible rules that orderly families make for themselves.

In the alley behind each house there must be covered iron garbage and ash cans. These are collected in separate wagons. Other wagons take away junk. Ashes and street sweepings are used for filling in low ground. In this way green parks have been made on swamps. Bones are sold to factories, to be ground into bone meal. One factory buys old iron and other metals. Another takes old shoes, another the wooden boxes and furniture. Rags and paper go to a paper mill. Garbage is burned in great furnaces that often save the fat for soap factories. London, in its poorest part, burns

garbage to heat water for public baths, and to make steam to run the machinery of laundries.

Well managed cities take all this waste away every day, or at least three times a week, and they do it early in the morning. Street sweeping is done at night when there are few people about. Then big, rotary sweepers, drawn by horses, whirl the street soil up into covered wagon boxes. In the day time, men go over the streets with long-handled brush brooms, dust pans and carts and water cans. They work all the time. Horses make soil, produce wagons and peddlers drop vegetables and fruits, coal wagons scatter lumps and dust, untidy people throw away papers, fruit skins and cigar stumps. Sometimes streets have to be scraped. Asphalt and cement walks and roadways are washed with a big hose. In Paris, miles of beautiful avenues are washed every morning before breakfast. The water carries the dust into the sewers. In most cities street car companies must keep the streets on which their tracks run, clean. They must sprinkle the tracks in summer to lay the dust, and clear away snow in the winter. The city sprinkles the roadways of the parks and boulevards, and waters the grass. House owners, on well-kept streets, pay for having sprinkling done.

Snow is one of the hardest things in a city to deal with. It cannot be allowed to lie on the ground as in the country, where it packs into hard, white roads. In cities snow is soon cut up into dirty slush, freezes into ruts and blocks the streets. In the crowded business parts, snow must be shovelled into wagons and carried away. Snow plows and scrapers go over avenues and through parks. A heavy snowfall costs a city thousands of dollars. Besides its stopping traffic, if it should melt all at once it would flood basements and sewers. That would force sewage into the streets and houses, and poison the people.

Street cleaning is only a part of city housekeeping. The health department's business is to see that all the people have pure air, pure water, pure food, and are protected from contagious diseases. The people pay taxes to build water works, and then pay for all the water they use. They pay taxes to lay sewer pipes. Gas companies are given the right to lay gas pipes in the streets. They make money from this right, so they have to obey special laws. Owners of houses, stores and factories, get rent from the people who use them, so they are forced by law to keep their property in good, healthful order.

The health office must warn people by public notice if, at any time, water should be boiled. If your plumbing or gas pipes are out of order, a city inspector will come for nothing to test them, and house owners must repair the pipes, or even tear them out and put new ones in, if necessary. If they refuse to do this the health office has the right to condemn a building, to allow no one to use it, or even to order it torn down. The law in most cities says that no man has any rights in property, above the rights of public health. If there is a dirty stable or factory near you that breeds flies, the health officers will see that the place is cleaned, for flies carry disease. City inspectors watch bakeries, markets, dairies, cold-storage houses and commission houses, to see that no spoiled food is sold.

A well managed city forbids many things that cause accidents. They make speed laws for automobiles, railway trains and street cars. Merchants cannot hang swinging signs over sidewalks, or use the walks for boxes and barrels. People who are putting up tall, new buildings must put wooden sheds over the walks to catch falling bricks, bolts and plaster. Street cars must have fenders to catch people who may fall in front of them, and they are allowed to stop only in certain places, so people will always know what a car is going to do. When a street is being repaired, a hole must be enclosed at night, and a red light hung above. Theaters cannot crowd the aisles, and must mark exits in big letters and with red lights. In a number of cities, railroads are elevated. Even with all the things that are done to protect people, every city has thousands of accidents a year by which people are injured or killed. Many of them are caused by carelessness. One good thing to remember is, that there is more room behind a moving car than there is in front. Another is that a city street is not a safe playground for a child.

It really seems as if cities are more careful of children than many parents are. Many city health departments print little books telling mothers how to feed babies in the hot summer months, when so many babies die. The laws about milk are very strict, for milk is the only food of helpless babies and many sick people. Cities often have fresh air sanitariums in parks for sick babies, and bathing beaches for older people.

Within the last few years, big city school boards have hired school doctors, and visiting nurses, who work with the health department to keep school children well. These doctors examine children's eyes, ears, noses, throats, teeth and skin. They watch for contagious

diseases and keep them from spreading, and they find and cure many children who are in the early stages of tuberculosis. They tell parents what to do for sick children. If the parents are too poor to pay for glasses, for dental work, for removing ad'en-oids from noses, or for any other trouble, the children can be treated at free dispensaries and hospitals. Every city has public hospitals supported by taxes, to take care of poor sick people. There are special wards for contagious diseases, and cities are beginning to build camp hospitals and sanitariums for people with tuberculosis.

One of the things that all cities and most towns do now, is to forbid spitting in public places. This is a filthy habit, very offensive to clean people. And now it cannot be allowed at all, because tuberculosis, "the great white plague," that kills so many thousands of people, is known to be spread by spitting. Signs forbidding it, and warning people that they will be fined, if caught, are put up in street cars and public places. People are warned, too, not to use public drinking cups without washing them thoroughly. The only safe cup to use is your own, or one set in a fountain basin with water overflowing it all the time.

After a child is reported well of scarlet fever or other contagious diseases by a doctor, city health officers come and disinfect the house. To disinfect is to kill the disease germs. They do this by filling the house with fumes of for-mal'de-hyde. Clothes that can be washed must be boiled. Rugs, mattresses and bedding are taken away to the city's plant to be disinfected and returned. Then the warning card is taken down, and the family may mingle with other people.

You know how you like to be "head" in school—to be the best in everything. Cities like to be "head" in health. They keep records of the babies born, the number and ages of people who die in a year, and the diseases they die of. If a great number of deaths are from preventable accidents, or diseases caused by contagion, bad water, bad food, or bad drainage through sewers, a city is very much ashamed. Besides, a city with a low health record is not a good place to live in, so people who move from one city to another avoid it. Cities are rivals for people and trade. They all try to go "up head," in health. To get there takes an army of street cleaners and inspectors and officers. The work is hard and dirty, and often dangerous, and it is never done. The good-health brigade is always on duty, standing sentinel, cleaning camp, scouting for the enemy, and fighting the foes of dirt, disorder and disease. They are soldiers of peace.

II. FIRE FIGHTERS

Do you have fire drills in your school? If you do, the fire signal is struck on the gong at the most unexpected times. That is the way a fire happens, you know. When the gong strikes, every child jumps into line. Coats and hats and books are left behind. Children start from three floors at once in a big city school, going four abreast down wide, shallow stairways. By the time those on the second floor are down to the first, the little tots are out of doors. A big building of twenty-four rooms, and nearly twelve hundred pupils, on three floors, can be emptied in one minute and a half. It would take a racing fire to beat that, wouldn't it?

If you don't have a fire drill, you should have. Some day there really might be a fire, and then the children wouldn't know how to get out quickly and safely. Frightened children, and even grown people, run and scream and stumble. They knock other people down and fall over them. There was one such school fire, in which hundreds of children died. We never want another one. There was a dreadful theater fire, and one on an excursion boat. In all these fires, laws had been disobeyed. By these terrible fires we learned a great many things that we should never forget.

New buildings for schools and for public use should be made fireproof, but old buildings can be made much safer than they are. Every father and mother should know if a child goes to school in a safe building. The doors should open outward with a push, and should never be locked in school hours. The stairs should be wide, and shallow, and the treads laid on iron or cement. If a school house is two stories high there should be iron fire escapes from halls, marked in big letters, and with a red light that can be seen through smoke. The basement floor should be of cement, and there should be no rubbish closets for the janitor, under stairways. Hot ashes should never be near wood. Chimneys should be examined and cleaned every year. The furnace should be in a separate building, if possible. *And* there should be frequent fire drills.

The United States has the best fire fighters in the world. We have the best trained and most daring firemen. We have the best engines and horses, hose and ladders and the best water supply. Foreign countries send men to our cities to see our fire companies



AN ENGINE RACING TO A FIRE IN ANSWER TO AN ALARM CALL.



PUTTING OUT A FIRE.

Firemen drag the hose up long ladders to reach the upper stories. To reach high buildings, hose is attached to the top of the tower, as seen on the engine at the right. Sky-scrapers have standpipes running from the ground through the floors to the top through which water is forced.



CLEARING THE STREETS AFTER A HEAVY FALL OF SNOW.
The snow is loaded into carts and motor trucks and carried away.



Photo, Brown Bros.

HOUSEKEEPERS ARE REQUIRED TO PUT THEIR GARBAGE INTO CANS.
Here the city employees are gathering these cans and loading the contents into carts to be taken to the dump.

put out fires. Isn't it strange, then, that more lives and more property are lost by fires, in our country, than in England or Germany or France? We pay out more money for fire insurance, too. This is partly because ours is a newer country, and much of our building has been done with wood. We are building better, today. But most of our fires are caused by carelessness. The best way to deal with a fire is not to let one get started. Here are some of the things to remember:

Never drop a match. Even if it is unlighted, some one may step on it and set it on fire. Keep matches in covered metal or china boxes, away from children and mice. Mice bite match heads and often set whole boxes on fire. Be careful of fire crackers. They often explode in rubbish, under wooden steps and ladies' dresses. Don't build a bonfire, or play around one, unless some grown person is watching. Don't leave little children alone in a house or a room, with a fire or a lighted lamp. If you build a camp fire anywhere be sure it is out, not a hot coal left in the ashes, before you leave it. Forest and prairie fires that have swept away towns have been started that way. Don't allow loose rubbish in basements and closets. Don't use gasoline, kerosene, naphtha, benzine, alcohol or turpentine in a room with a fire, or keep these things stored in a house. Don't try to start a fire with one of these things, or to fill a stove tank or lamp while it is burning. There are easier ways to die than by oil explosions.

Use a deep kettle, only partly full of boiling fat, for frying doughnuts. Don't force your furnace in cold weather. Overheated chimneys cause fire. Test your gas pipes and burners often, and don't look for a gas leak with a lighted match. If you can't find it with your nose, send for a plumber. Don't light lamps or gas jets near lace curtains. Watch a grate fire, or put a fender before it. Coal snaps out sometimes. Be careful of punk and incense sticks. Don't put candles on a Christmas tree. They look pretty, but they are dangerous. Maybe you can think of some more don'ts. Yes, here is another. Don't air bed clothes, or put flower pots on the fire escape. It may be needed any minute. Besides, it is against the law to block a fire escape, and you could be punished for it. Here are some "dos" to remember about fire.

When you move into a new neighborhood, find out the nearest fire alarm box, the first thing. It will be painted red, and have a red light above it at night. Ask a policeman how to send in an alarm. If you have a telephone, put down the number of the nearest engine house and police station, so you can call for help, if you can't get

out of a burning house. Study all the possible ways of getting out of a house. If it is a tenement or apartment building, with a fire escape, see if the escape is kept clear. If other tenants block up the escape, tell a policeman and have it stopped. See if the school is safe, and has fire drills. If not, refuse to send your children into a fire-trap, and arouse public feeling about it, so the school will be made safe.

When you go to a theater, public hall, church gallery, department store or factory, mark the EXIT and the red light nearest you. If a fire starts make your way out quietly. Don't scream or push in a crowd. A panic is easily started, and more people are killed by falling and being trodden on than by the fire. Talk cheerfully to people near you. Tell them how quickly a big school house is emptied in a fire drill. Help old people and children. If you are stopping in a hotel, locate the stairways, the elevator and the fire escape from your room. If there isn't a coil of stout rope in your room, long enough to reach the ground, ask the clerk for one.

A small fire can be smothered. You know fire cannot burn without air. If your clothing catches fire, roll up in a rug or heavy bed clothes. If out of doors roll on the ground. A boy's or man's thick coat will often put out a small fire. Pull a blazing curtain down and smother the flame. Throw a mattress on a burning floor. If you are caught in a burning house get out, if you can, without going through flames and smoke. When air is full of smoke the oxygen is burned out, so it can not be breathed. That is why people fall and are killed by smoke, even when the flame does not touch them. The best air is always near the floor, so you would better crawl. If you cannot get out, close the doors between you and the fire, go to a window, open it and stand there and scream for help. Then wait for the firemen. Don't jump. You can lower yourself from a second or even third story window, by a rope made by tearing sheets in wide strips, knotting them together and tying one end to a bed post. You can let a child down by such a rope.

Do you know how quickly a fire company can get to a fire? You ought to be in a city engine house sometime at midnight, when an alarm is turned in. It's like a cavalry charge on a battle field. A man sits at a desk under a gas jet. Another man is reading. This is the night watch. The big engine's shining brass trimmings wink in the light. The horses stand with drooping heads in the stalls. The harnesses hang from the ceiling, above the engine pole. Over-

head, the firemen are asleep, half-dressed, in a big room full of cot beds. Stout poles set in big rubber pads go up through manholes to the upper floor. You wonder what these are for.

Suddenly the brass gong strikes four-two-one. That is the "forward charge!" for that engine house. "Turn out," yells the man at the desk. But everyone has turned out. The firemen drop through those holes and slide down the poles. They button their coats as they run. The touch of an electric button unhitches the horses and they leap in front of the engine. The driver springs to the seat and gathers up the reins. That act drops the harness from the ceiling to the horses' backs. Snap, snap, snap, go the harness buckles, under a dozen pairs of hands. The night watch thrusts a torch into the fire, under the engine boiler. Men spring to the hose tender, slipping into rubber coats and helmets as they jump.

With a pounding of hoofs, the big percheron horses are off. Smoke already comes from the stack. Clang, clang, rings the bell. Clear the streets, get out of the way! The desk sergeant has shouted the number of the box the alarm came from, and the engine makes straight for that corner. The person who sent in the alarm, or a policeman who stands there, tells the fire crew where the fire is. In two minutes from the alarm, the hose is screwed to a water hydrant six blocks from the engine house and the engine is pumping water into the burning building.

The first thing to be saved in a fire is life, the second property. A hook and ladder truck is there as soon as the engine. Firemen run up stairways and ladders to find people. They knock at doors and shout to people to answer them. If they hear a scream or a moan, they break down doors and go right through flame and smoke to carry people out.

One fireman can bring down four people at once on a long shaking ladder. He can hook two children to his belt, and bring a mother and baby on one arm. Back he goes into the flames. This time it is a two-hundred pound man, overcome with smoke, that he brings down. Firemen creep along dizzy window ledges, where you would not think a cat could go. They climb on roofs and drop through skylights. They make bridges across alleys and courts with ladders; they hang over roof cornices. Firemen every day do deeds of daring that you would think impossible.

Every day these brave fire fighters are killed, or injured for life. Burning shutters, cornices and awnings fall upon them. Sometimes

a roof falls in with them, or an explosion blows a building up. In winter the water freezes as it falls on them. After one fire, the boots and gloves of the firemen were frozen on them and had to be cut off. Sometimes a fire company has to stay out thirty-six hours. Firemen never leave a spark, as careless campers often do, to start a new fire.

No matter how long they have been out fighting a fire, when they get back to the engine house the horses must be rubbed down, fed and watered, the engine must be cleaned, the fire raked from under the boilers and another fire laid ready for instant lighting. Only then can they bathe and eat and go to bed.

They go to bed to sleep with one ear open for the alarm. Day and night firemen are sentinels on duty, always ready to spring at the enemy. They are always ready to risk their lives to save the lives of others. Many cities pension their injured and worn out firemen, just as our country pensions soldiers. Don't you think all good citizens should be careful not to let fires get started? Even little boys and girls can be that kind of fire fighters.

III. FIGHTERS FOR LAW AND ORDER

When you grow older you will study the Declaration of Independence. This is a paper that was signed by some heroes who started our United States. They wanted a country where everybody could be free and happy. So the very first thing they put into that paper was that every person has a right to life, liberty and happiness. The Declaration of Independence is America's Golden Rule. Every one who lives here may live where and how he likes, go about freely and enjoy himself in his own way, so long as he doesn't interfere with other people's rights. That satisfies most persons, but there are selfish and even wicked people who want more than their rights. To get what they want, they do not care how much trouble and pain and loss they make for others. So we have to have laws, telling people what they are not allowed to do, and officers to make people obey those laws.

Laws are just rules for good behavior. You know how unhappy one selfish, ill-tempered person can make a whole family. It is the same in school. One unruly pupil can make trouble for a whole room. One boy who is a "bully" on the playground, can spoil everybody's fun. Little law-breakers become big law-breakers when they grow up. Then they find out that if they interfere with other people's life, liberty and happiness, officers of the law will arrest and punish them. It is better to learn to be good citizens in the home and school, so it will be easier to obey laws when you grow up.

If you live in even a small village, very likely you have a town marshal. He tells boys they must not throw stones or snow balls in the streets for they might break windows, or hit people or frighten horses into running away. He tells them not to build bonfires in the streets, or near fences and barns along alleys. He tells them not to climb shade trees or fruit trees without the owner's permission, for they might break limbs. He tells them they must not chase cats, or tie tin cans to dogs' tails, or rob birds' nests, or use sling stones on birds. The law forbids cruelty to helpless animals. You see, all these laws are just good common sense and kindness.

In small places, very few people break laws because everybody knows everybody else, and a selfish, troublesome person soon gets himself disliked and goes away. He is apt to go to a big city. He

thinks where there are so many people he will not be noticed, and he can do as he pleases. But there he finds a whole army of policemen whose business it is to keep order. Policemen are the friends and protectors of everyone who behaves well, and the enemies of everyone who makes trouble for others.

Policemen always look out for children. Some school houses in cities are on crowded street corners, where street cars, wagons and automobiles are always passing. Often the children have to cross railroad tracks to get to school. In such dangerous places there is always a policeman, in a blue uniform and brass buttons, to help the children across. When he lifts his stick or his hand, every car or wagon driver has to stop. He can arrest a man who disobeys him. Very likely he has little ones of his own at home. Very often he picks up a little first grader who is afraid, and carries her across the street. If a policeman finds a lost child on the street, he calls a police wagon and gives the baby a fine ride to the station house. There he is fed and petted and put to sleep. Then the policeman goes to find the baby's mama and papa. A policeman is the best *strange* friend a little boy and girl can have. You see, he is a peace soldier. It is his business to take care of people.

Policemen are often in as great danger as firemen. Sometimes they beat the firemen to a fire. If they do, it is their duty to go into a burning house and help get people out. They often stop runaway horses, and they snatch people from under horses' hoofs and car wheels. They dive into park lagoons, into rivers and harbors to save people from drowning. The most dangerous work policemen have to do is to find and arrest criminals. Many of these men, who live by robbing people and houses, will kill rather than be captured and sent to prison. But policemen will answer a shout for help, a whistle or a telephone call. They will go right into dark basements and alleys, after men who may be waiting for them with pistols and knives. Plain clothes policemen are in every big crowd watching for pick-pockets, and in dangerous parts of the city where criminals try to hide, learning to know their faces and their habits.

The very tallest, strongest policemen stand in the middle of two crossing streets in the most crowded part of the city. They can see all four corners and crossings, can guard people who are afoot, and keep the wagons and cars from getting in a tangle. They can stop a stream of traffic by lifting a hand, and send it on again. Some policemen are mounted on horses or bicycles. These are in

parks and along speed-ways, to stop automobiles and horses that are going too fast. There are special policemen who watch railway stations and boat docks, where visitors who do not know city ways are likely to get into trouble. There are always a great number along the line of procession, at fairs and celebrations, and where there are labor strikes.

The policeman you know the best is the patrolman. Patrol is a soldier word. It means to walk over and guard a district. A police patrolman has several blocks to watch. He goes over his district several times a day. At night, another man takes his place. The patrolman has to see that no law is broken, and that everyone is protected. Some night, when you are asleep, there may come a ring at the doorbell. A policeman calls up that he found a basement window unlocked. He goes through the place to see if some burglar has broken in. No, he says, you were careless and left that window open. Your father thanks the policeman. And that makes you all the more careful afterwards.

A policeman must see that people obey the health and street cleaning laws. He must stop fights and scatter noisy crowds. He must make people keep things off fire escapes. He must arrest any one whom he finds abusing a child or an animal. He must take care of any person injured on the street, send him home or to a hospital, and arrest any one who is to blame for the injury. If a man is out of money, and has no place to sleep and eat, he can always go to a police station. That is a safe, public lodging house for a night.

Always answer a policeman's questions and obey his orders. He is an officer of the law and he has a right to stop and question people. He has a right to your help, if he needs it. Sometimes boys have clubs or "gangs," just for fun. Policemen are apt to watch "gangs," for they know that crowds of boys often do selfish and mischievous things. But don't look upon them as enemies. Be open and above board, and don't hide or try to play tricks. Active boys can help a patrolman keep order in his district, for they see everything that is going on. In some cities boys have formed law-and-order clubs, and have been given badges to wear by the Chief of Police. Districts that have a band of little citizens helping the police are always cleaner and more orderly, and are shunned by sneak thieves and mobs. Some boys in such clubs have won medals for bravery in fires and for protecting animals that were being abused.

There's a lot of fun in being a little law-and-order soldier. Try it.

HOW AND WHY OF COMMON THINGS

EDITORS' NOTE TO MOTHER AND TEACHER.—There is a period in a little child's life when he is just an animated question mark. He wants to know the how and why of everything. Now this betrays a very large and useful curiosity. Curiosity, persisted in and intelligently directed, has made all of the great discoveries of the world. You can discourage it if you keep on answering: "Oh, just because it is," or: "Run away now, and don't bother me." But stop and think if you really do want to nip that beautiful flower of the soul in the bud. Until long after he can read in his little school books, the child, unhelped, can make little use of our vast storehouse of print. Father and mother and teacher are the sources of wisdom to him. If these fail him, he can only fall back into vacuity, or mischievous or dangerous experiments.

"But," you say, "so many of his questions are foolish." Are they? Or is it because you don't know the answers, are unwilling to admit your ignorance, and unwilling also to take a little trouble? Some of the questions are unimportant, no doubt, some impertinent. Those kinds are matters of good sense and good manners. Very few of the questions are foolish. To the little child, the world is full of delightful mysteries. His senses are keen to first impressions, and he observes a multitude of natural phenomena. He instinctively knows, long before he can reason about it, that every effect has a cause. Hence his endless hows and whys.

Simply with the idea of satisfying this curiosity, and relieving the harassed parent and teacher, we collected nearly one hundred typical questions asked by children of active minds, and searched out the answers. The result was very astonishing. Nine-tenths of them steered inquiry straight into the natural sciences—not only into botany and zoology, but into physics and astronomy. We began to understand the adult point of view a little better. Far from being foolish, these questions were profound. It would require the wisdom of the sage to answer all of them, or a library of reference books far beyond the reach of the ordinary family, school or village. It revealed to us a new wonder world of the little child's mind; and humility that we fall so far below his demands. If we can answer a few of his questions here, and change the attitude of his parents and teachers toward his questions, we shall feel that we have helped the world along a little way.

Now, when a little boy asks: "Why does doggie turn 'round and 'round, before he lies down?" or "Why does rain fall in little round drops?" we shall be able to look the little questioner frankly in the face, and say: "I don't know, dear, but I'll try to find out."

So here we start on a voyage of discovery into the fairy-world of how and why.

HOW MOVING PICTURES ARE MADE

The making and operating of Moving Pictures has grown into a great industry, the manufacture of films by one concern amounting to ten millions annually. While devoted largely to amusement, the Moving Picture has become also an important educational factor. The following illustrations explain the optical principles involved, and the mechanism used in this curious and fascinating invention.

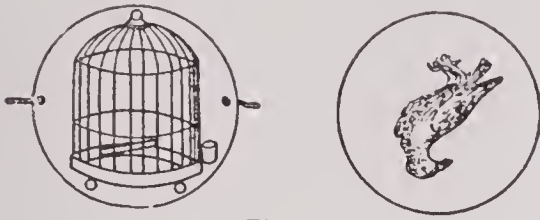


Fig. 1

Take a round card like this, with a picture of a cage on one side and a picture of a bird on the other and make it whirl by means of a twisted string. It will look as if the bird is in the cage, because the image of the cage does not fade from the eye before the image of the bird is added to it. It is this "persistence of vision," as it is called in Optics, that makes "moving" pictures seem to move.



Fig. 2

Picture No. 2 further illustrates this principle. Each of the little figures is in a slightly different position from the other. When one disk is turned and the figures are looked at through the slits in the other the figure seems to be jumping a hoop. This is because one image remains in the eye while another image, showing the arms and legs in a slightly different position, is added, thus causing the figure to seem to move.

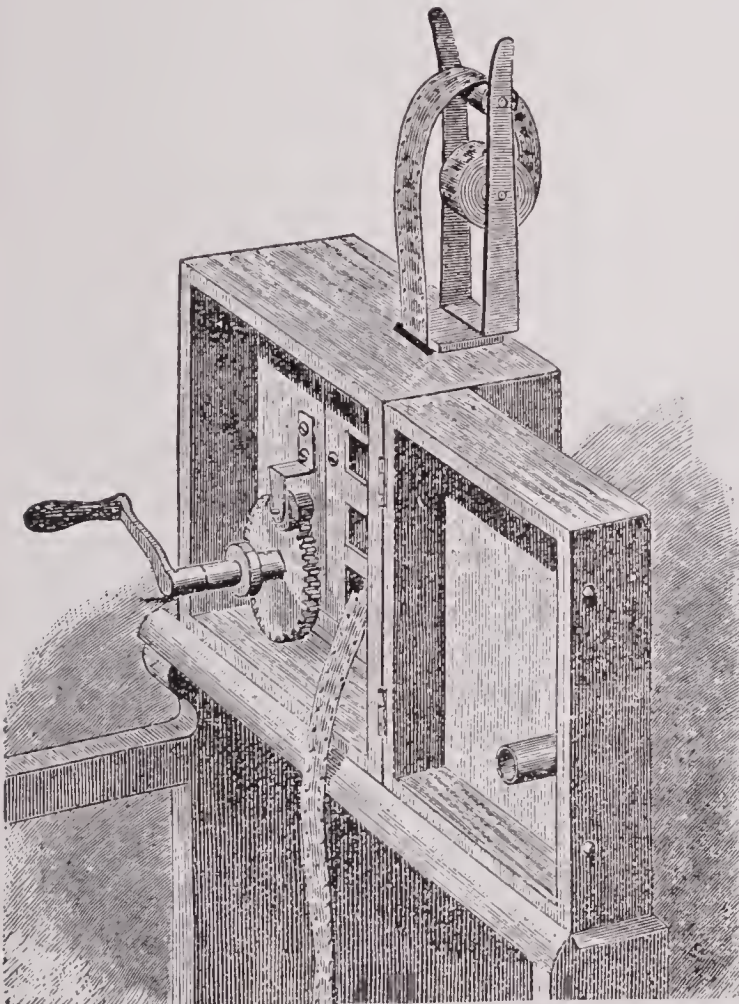


Fig. 3

In order that each successive photograph may show a moving object in a position only slightly different from the preceding picture, photographs for moving pictures are taken very rapidly. At the moving picture show these photographs are run rapidly past a lens which magnifies and throws them on the screen. Figure 3 shows a moving picture machine with the reel of films in place. This style of machine is called the Cinematograph.

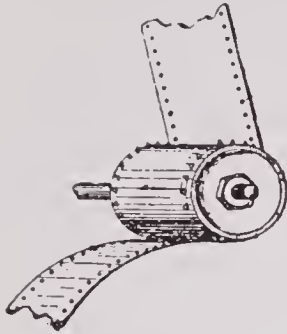


Fig. 4

To make moving pictures show clearly and distinctly on the screen it is necessary that each succeeding photograph be held in exactly the same position as the preceding photograph. Notice (Fig. 4) that the films have holes on either side. Into these holes fit the teeth of a wheel. As the wheel is turned these teeth catch in the holes, draw the film from the spool and hold each picture in position before the lense at the very spot where the preceding picture stood.

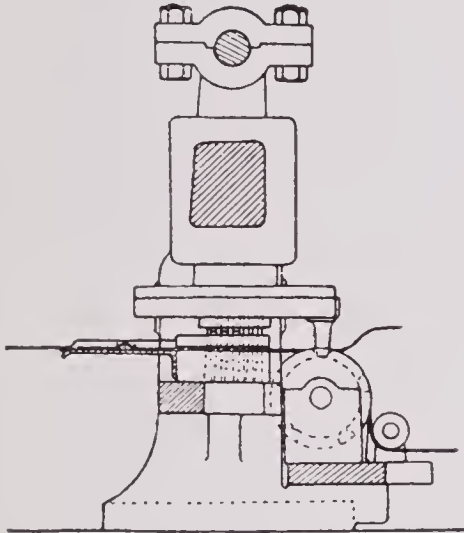


Fig. 5

Figure 5 shows the machine which punches these holes in the film. The film is fed into the machine from the left and is held steady by two small rollers, one of which you see in this end view of the perforating machine. The film is drawn along by a sprocket wheel—that is, a wheel with teeth like the sprocket wheel on a bicycle. These teeth fit into the holes in the film, as fast as they are made.

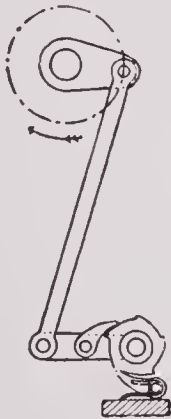


Fig. 6

Figure 6 shows how the wheel is stopped each time, after it has turned the length of one film. This stopping device is called a ratchet gear. You have seen ratchet gears on windlasses. Whenever the wheel stops a tooth drops into a hole in the wheel and holds it while the film is being perforated. Some of these machines make 15,000 perforations in an hour.

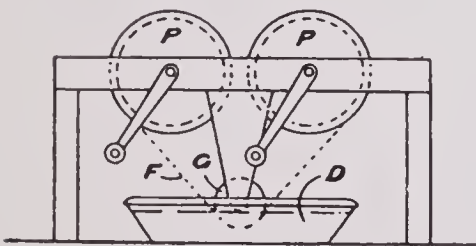


Fig. 7

After a series of moving picture photographs have been taken the negatives must be developed. This is done by means of what is known as a "skeleton reel." These reels are about three feet in diameter and seven feet long. They are mounted on standards. Figure 7 shows one style of developer. P and P are two drums. F is the film. D is the developer trough in which is the chemical solution through which the film is made to pass under the roller G.

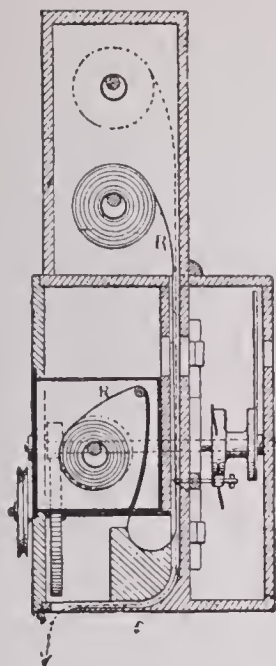


Fig. 8

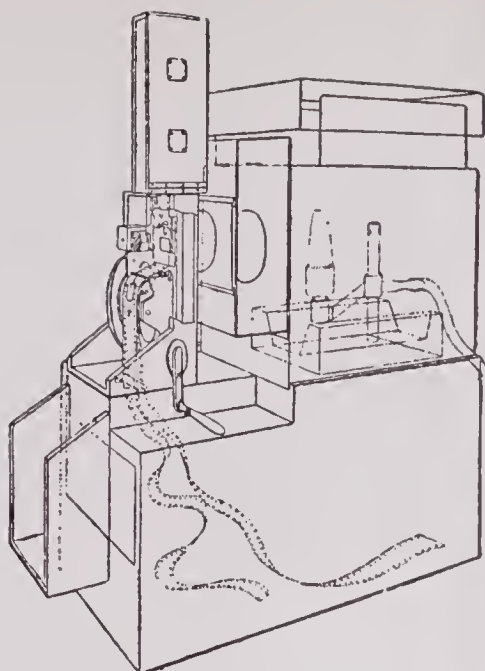


Fig. 9

After the development of the negatives comes the printing. The printing requires even more care than the development of the films. If the films have been stretched or if the pictures are not kept at exactly the same distance apart in printing, the pictures, when thrown on the screen, will have that trembling motion and blurred appearance which is so disagreeable and so hard on the eyes. Figure 8 shows a Cinematograph machine printing positives on a film R. The negative is wound on the upper spool. The film passes into a box. This box is a "dark room" that admits light only at the point where the two films pass. As they pass this little window the picture on the negative film is printed on the positive film, just as the sun prints photographs exposed in a frame. Figure 9 shows another view of the same kind of a machine.

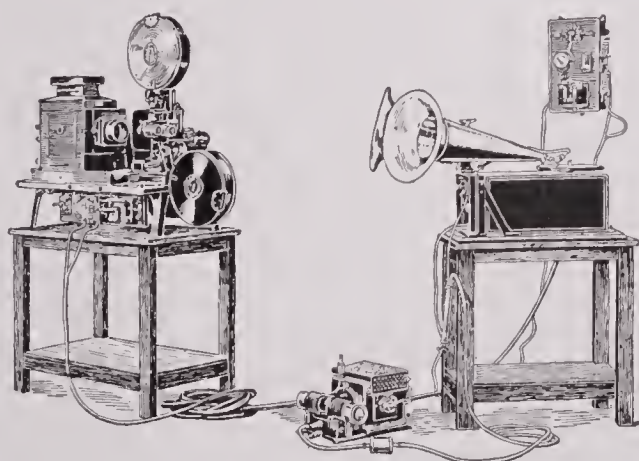


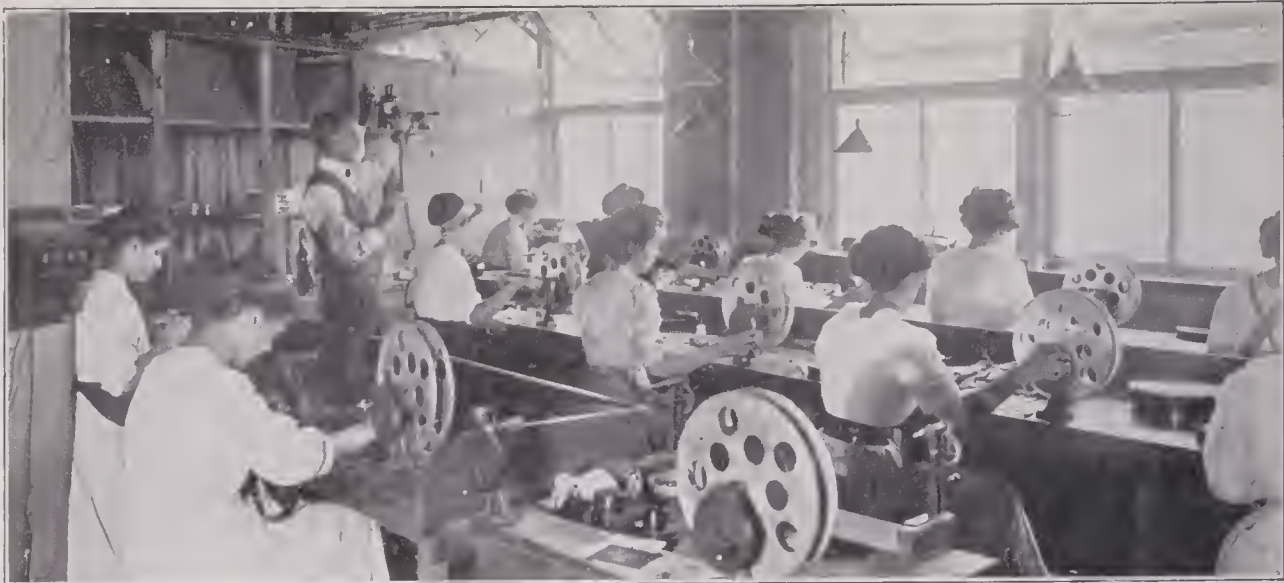
Fig. 10

By means of the apparatus shown in Figure 10 the moving picture is made to talk. Both the camera on the left and the phonograph on the right are operated by the electric motor you see on the floor between them. As this motor controls both the camera and the phonograph at the same time, the words are always made to fit the picture.



Copyright by Brown Bros.

This is a picture of a moving picture film, actual size. On either side of the picture there is a margin like the unprinted part of a postage stamp, or the selva on a piece of cloth. In this margin the holes are punched for controlling the films in the picture show camera. This is a picture of a man who is troubled by the appearance of ghostly visitors. Notice how slight is each change of position of the actors as you pass from picture to picture.



Copyright by Brown Bros.

Here the films are being transferred from the picture taking camera reel to the reel for the show. You can see two of these "picture ribbons" passing from one reel to the other in front of the two girls to the left in the middle row. The man is examining a reel to see if there is any defect in it. Notice how much window space this room has. This is because the pictures must be examined and watched very carefully for defects before being shipped.



Copyright by Brown Bros.

In taking moving pictures a camera is used substantially the same kind as that for throwing them on the screen at the show. The reel containing the films, however, is on the inside of the outdoor machine. This is for convenience and safety in moving about. The man on the left is shouting directions through a megaphone to the actors. As soon as the other two get the camera into position and very firmly set on its three solid legs, the men on the right will turn the crank. The film will pass rapidly before the lens.



Courtesy of Technical World.

Film makers go to great expense and trouble in making the films which cost you only five cents to see. This picture shows a head-on collision of locomotives taken for a moving picture company, which occurred at Indianapolis on July 4, 1911, and was arranged by the Society of American Engineers. There was an engineer in charge of each locomotive. After opening the throttle and sending the locomotives toward each other at the rate of sixty miles an hour, the engineers jumped from their cabs.

HOW AND WHY OF COMMON THINGS

WHAT ARE TEARS FOR?

That is what a little blue-eyed girl asked her mama, when told that she shouldn't cry so much. She had the perfectly right idea that there must be some good reason for tears since she had so many of them and right "on tap" all the time.

"Why," said her mama, "tears are to wash your blue eyes with, of course. Eyes are little windows of the soul. In this dusty world windows become dim. Unless they are washed often we cannot see through them very well. Every time you wink, two tears come and bathe the eye-balls. What a lot of washings. And how bright and clear your eyes are, like the blue sky after a shower."

Back of the upper, outer corner of each eye is a tear bottle or bag, about as big as an almond nut. In some strange way this gland makes tears, stores them, and lets them out through several little hair-like tubes. The winking of the upper eye-lid spreads the water over the eye-ball. The tears flow away through little canals, that open from the lower inner corners of the eye into the nose. Most of the time just enough tears come to keep the eye-balls, the lining of the eye-lids and of the nose clean and moist. But several things will make the tears come with a rush. A bad cold, a big cinder in the eye, or a very little hurt or trouble anywhere on the body, or in the mind or heart, sometimes, will make the tears gush out. Just why one should feel like crying when hurt, or in trouble, no one knows. The writer has noticed that certain feelings of pain or grief make the eye-balls burn. Very likely tears flow to relieve this burning sensation, since tears are meant to protect the eyes from injury. But if one weeps too often, or too long at a time, the tears themselves are harmful. The salt in the tears inflames the eye-balls, lids and nose and makes them red and swollen. Many children cry too easily over trifling hurts and troubles. That isn't *using* tears; it's mis-using them.

DOGGIE KNOWS WITH HIS NOSE

If you have a dog it will be very interesting to find out in what way he knows you. Mr. John Burroughs says he appeared one day before his dog in a new outing suit of khaki. The dog eyed him suspiciously and backed away. Threatening him with a stick, the animal became excited and angry. When he spoke in his usual tone the dog came to him and smelled him. He acted very much ashamed for not knowing his master. A dog trusts his nose more than he does his eyes. When a shaggy dog is clipped close for hot weather, his dog friends think him a stranger. They jump out and bark at him. But when they come close enough to smell him they look very foolish over their behavior. A good house dog knows the members of the family and all the friends who come about the place by their smell. A stranger he detects instantly in the darkest night. Next to their sense of smell is hearing. Dogs know familiar voices. They trust their eyes the least of all and are thought to be near-sighted. For odors they have wonderful memories. It is this that enables many lost dogs to find their way home over long strange roads. While all dogs have keen scent, the bloodhound and other hunting dogs have it to an astonishing degree. Descended from breeds of wild dogs, that had to hunt distant and unseen prey, they learned to follow the scent of one animal through a confusion of other smells and to pick up a trail lost in running water. By their sense of smell collie and other shepherd dogs trace and find sheep lost in storms. The St. Bernard dogs in the Alps Mountains find travellers buried in the snow. Terriers have keen noses for rats, and other burrowing rodents. Try your dog by changing clothing with a little friend. He will jump first on one, then on the other, and show plainly that he is puzzled. You may have to speak to him before he is sure which is his master.

WHAT IS SMOKE?

That depends upon the kind of fuel that is burned. Smoke from a fire of dry hard wood, from anthracite coal or from a gas flame is chiefly a column of hot air. Often it cannot be seen. There is very little solid matter in it. The thick, black smoke from locomotives, factories and house chimneys is made by burning soft coal in a wasteful way. If you will turn back and read the little story of how gas is made, you will understand the changes that take place when coal is heated. In making gas, the coal is not burned but is

roasted in an airless retort or oven. The heat sets the coal gas free. This is allowed to escape into a tank where it is stored for future use. When the oven is opened there is found, not ashes but coke, the carbon of the coal. Nothing has been consumed. The gases and the carbon have simply been separated. Both the coke and the gas can be burned and with very little smoke.

In all coal fires this separation of gases and carbon takes place at low, roasting temperatures—too low, indeed, to heat our houses or to make steam in boilers. Put a shovelful of soft coal into your furnace and watch the thick, yellow gas hover over the black mass before it bursts into flame. Open a draft below the fire box. The oxygen in the air helps to make a hotter fire. Hot air rises. You can see these gases and coal dust rush up the smoke pipe, on the column of hot air. They are carried away before they have time to burn. Of course, then, you understand that smoke means waste of fuel. Under boiler and house furnace fires, from two to five tons of coal are burned to produce the heat that is in one ton.

For more than a hundred years it has been understood that we could save a lot of money if we burned our smoke, and at the same time make this world a sweeter, cleaner, healthier place to live in. Coal gas is poisonous to breathe, and carbon dust is bad for the throat, nose and lungs. Both are bad for plants, for grass, flowers and shade trees. Countless smoke-consuming devices have been patented since James Watt took out a patent in 1785. These devices have aimed at two things: Skillful feeding of fuel and management of drafts to make less smoke, or trapping the smoke and feeding it to the fire again. Some men who have studied the smoke problem, think that all soft coal should be turned into gas and coke at the mine, and then be burned separately, the gas sent to cities through big pipes. This would be possible for factories and houses, but not for locomotives and steam vessels. Can you tell why? There are several fortunes in this field of invention for bright boys who will be men by and by. Any boy has a good beginner's text book on the smoke problem, in the furnace at home.

WHAT IS COLOR BLINDNESS?

There are a certain number of people in every hundred whose eyes seem to be perfect except in color seeing. One doctor has discovered that one person out of every fifty-five cannot tell red from green. One in sixty confuses brown and green. Pink and yellow

look alike to some people, and blue and green to others. To a very few people everything looks to be black and white. The cause of color blindness is thought to lie in the nerve fibres in the retina, or screen at the back of the eye, on which pictures are thrown. Three nerve fibres are supposed to give sensations of red, green and violet. Orange, yellow and blue are seen by combinations of sensations. Now one of these fibres, most often the red, may be non-sensitive. That person will not see red at all. White to him appears bluish-green, with the red rays in the white absent. Violet looks blue, orange yellow.

In some cases there may be a total absence or paralysis of a nerve fibre sensitive to a certain color. But in a great many cases, it now appears that a defective color sense can be developed by proper education, just as the sense of form, size and distance can be educated. Perhaps you have wondered why brightly colored cards, pegs, wools, crayons and paper weaving-mats are used by the children in kindergartens, and in the baby grade in school. Teachers find little children as clumsy with their eyes as with their fingers. Many little children appear to be tone deaf, also, although hearing perfectly otherwise. It was a wonderful discovery in education that our five senses can be developed and trained. Thoughtful people noticed that women see colors better than men, as a rule. Girls have no better eyes than boys, but their interest in dress, house furnishings and flowers, brings colors into their daily lives. In France there are men silk dyers in factories whose color sense is so developed by use that they can grade sixty shades of gray.

Perhaps some boys who read this may think color of little importance in business, except to artists, decorators and dyers. Well, a farmer who could not see red would not be a good man to pick cherries. And how about signal lights on railway lines, lighthouses, bridges and in mines? Some wrecks are thought to be due to the inability of the engineer or pilot to tell red from green. Many railroads now examine the eyes of train men to detect color blindness. Since experiments show that the sense of red is most apt to be absent, it would seem that red signal lights should not be used at all. Green and violet are said to be least often confused. To the man blind to red rays, violet appears to be blue. It would be an interesting game for you to test the color-seeing powers of yourself and of your family and schoolmates. It could be done by cutting up a set of kindergarten weaving mat papers and pasting the strips on sheets of white

paper. Each person should have a sheet and be required to label the colored strips in writing.

WHY THE NEEDLE IN THE COMPASS POINTS NORTH

Have you a little iron horse-shoe magnet? It looks like any other bent bar of iron, but pins, needles and other bits of metal will cling to the ends of the horse-shoe. They will even jump a little way to get to the magnet, and can be lifted by it. A magnet is much more than an interesting toy. Magnetism is one of the biggest forces in nature. It is mixed up with electricity and stormy weather and all sorts of things. Our big, beautiful earth is a huge magnet. Its greatest points of attraction are at opposite ends, just as they are in the little horse-shoe magnet. One end of the earth magnet is away up near the north pole; the other is just as far down, near the south pole. These places are called the earth's magnetic poles. Their attraction for iron is made use of in navigating ships on the ocean.

The little instrument that, by the attraction of the magnetic poles for iron, is used to find directions at sea, is called the compass. It is a round box with a glass cover, and with a dial marked off something like the face of a clock. Over the dial a double-pointed needle—like the hands of a watch—swings on a pivot around the center. But the dial of a compass is not marked off in figures like the face of a watch. It is lettered. "N" means north, "S" south, "E" east and "W" west. These letters divide the dial into four quarters. Between them are "NE," northeast, and so on, up to a great many subdivisions. The captain of a vessel holds the compass-box level. The needle swings around and points toward the north magnetic pole. He turns the box slowly until the needle end rests over the "N," north on the dial. Comparing that with the way in which the vessel is moving forward, he can tell in which direction he is journeying, and can direct the pilot to steer in any direction in which he wishes to go.

HOW THE MOON PULLS THE SEA

Did you ever go to the sea shore for a vacation? And did you build forts and dig caves in the sand on the beach? Then, when you went to play the next morning, you found the beach smooth. Your forts and caves were gone. Grown people told you the tide

came up and washed everything away. A tide is the rising and falling of the ocean along the shore. The moon pulls the water up and then lets it go again, so it falls back. See if you can understand it.

You know how the earth pulls the apple down? It pulls everything on or near its surface toward its own center. And everything near enough to be pulled, pulls back as hard as it can. The earth pulls the moon, and the moon pulls the earth. Although it is much smaller than the earth it is just the right size, for its distance away, to keep from falling into or away from the earth. We cannot see its pulling power on the solid parts of the earth. But the ocean is made of water. A slope of land, a brisk wind, many things set water in motion. It feels the pulling power of the moon. Whenever the moon rises over the ocean, it pulls the water that is just under it. So, a great wave, or tide, travels under the moon across the wide sea. When the shore is reached this wave rises higher against the rocks, or spreads over level sand beaches. When the moon sets, the wave goes back to the old level.

We know this is so because the tide always comes up with the rising, and goes out, or ebbs, with the setting moon. If the moon stood still, and always rose and set at the same hours, we could not be so sure that it had so much to do with the tides. But as the moon travels around the earth in twenty-eight days, it rises nearly half an hour later at any given place, every day of its journey. The tides rise just so much later every day, too.

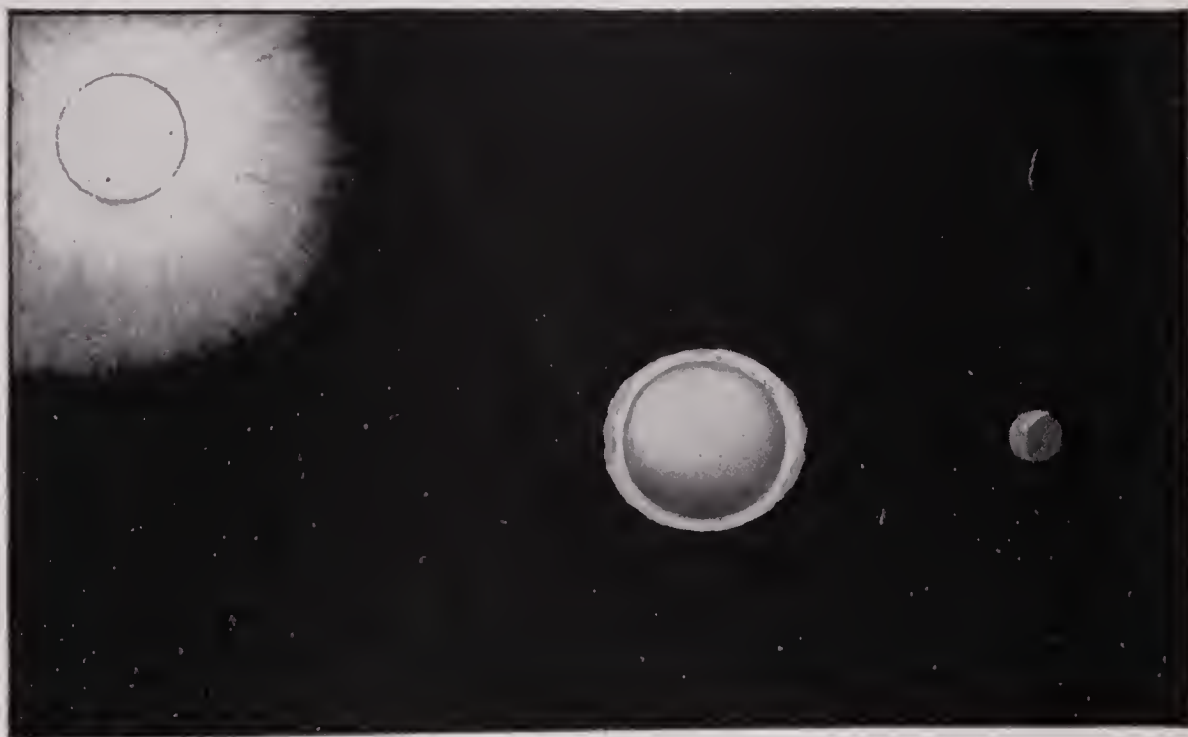
The sun also makes tides. But the sun is so very, very far away, that its pull on our waters is very much less than the moon's. We would hardly notice it if it wasn't for one thing. Sometimes, for a few days in every month, when the sun and the moon are both on the same side of the earth, they pull together. Then the tides rise the highest of all. About two weeks later in the month, the sun is on one side of the earth and the moon is on the opposite side. Then they pull away from each other. The moon wins, in this tug of war, but it cannot pull the water nearly so high. Twice in the month the moon's and sun's pulls are at right angles to each other. Then the tides are just of moderate height. If you live near a seashore, make a record of tide soundings or points reached by the tide every day for a month, with the time of the rising of the tide and the moon, and find out for yourself how the moon pulls the sea.



This picture shows how the moon attracts or pulls toward itself the water on the side of the earth nearest it, causing a high tide. It also draws the earth away from the water on the other side, leaving a high tide there.



In this picture the moon and the sun being on the same side of the earth, both pulling the same way, a very high tide is caused, called spring tide.



When the moon is on one side of the earth and the sun on another, as shown here, each pulling toward itself, the attraction of the moon is weakened and the tides are not so strong. These lesser tides are called neap tides.

SOUND WAVES AND THE TELEPHONE

"Hello, central!"

"Hello!" The answer comes back in a second. You don't know, perhaps, that as soon as you unhook the receiver, a tiny knob of light flashes out below your telephone number on the far-away switchboard of "Central." An operator, with a receiver strapped over her ears and a transmitter just below her mouth, sits before the switchboard. She is only one of dozens of young women operators. In front of each is an upright switch-board, or table on edge, that is punched as full of little round numbered holes as a honeycomb. Below each hole on the board, is a tiny glass knob no bigger than a shoe button. One of those little button lamps and one of those holes belong to your wire. When you ring up Central, your lamp flashes out on the board like a firefly. The operator sees it. She pushes a plug that carries a wire into that hole above the light, hears you and answers you.

"Give me Main 3908, please."

She pushes another plug on the end of a wire that connects with yours into the hole showing the number you called for. That rings the bell in the house of the friend you want to talk with.

"All right," calls the operator. "Put in your nickel, please."

"Hello! Is that you, Dick?"

Yes. You know his voice! And he knows yours, although you may be a mile, or ten or more miles apart. Then you have as nice a chat as if you were in the same room.

This wonderful thing is so common that we forget just how wonderful it is. Would you like to know about it?

Did you ever drop a pebble into a pool of still water? It makes a ring wave. Water rings widen and spread to the shores of the pond. Sound makes ring waves in the air. In a narrow valley these sound waves strike the rock walls and come back to you as echoes. It is these air waves that carry sounds to our ears (see ACOUSTICS, WAVE-MOTION and FAIRY PRINCE ECHO), but they do not carry them very far. Men who have gone up in balloons say that a mile up in the sky, the only earth-sound they can hear is the whistle of a locomotive. How far away can you hear and recognize the voice of a friend?

Now there are electric waves as well as air, water and light waves. Electric waves travel fast and far. By striking the key of a telegraph instrument, in dots and dashes that stand for letters

and words, messages are sent over wires charged with electricity, across wide lands and under wide oceans. These dots and dashes of sound are received just as they are sent. So telegraph operators know each other's ways of rattling off messages, just as you know the voices of many friends apart. It was long thought that electric wires would carry words and the very tones of the human voice, if a way could be found to get them *on the wire*. Of course, a spoken word cannot strike a key, as a finger can. But it can travel on an air wave, strike a rock wall and make an echo of itself.

"Make a wall, then, to catch air waves," was the idea the inventor of the telephone got. "But don't let the sound bounce back in echoes. Pass them on to an electric wire." The "wall" in the telephone, is a little round thin iron disc about as big as a penny, stretched as tight as a drum head. That is what you have in your ear—a drum head—to catch and pass on sound to the nerve of hearing. The auditory nerve is a sort of telephone wire to the brain.

This little iron drum head in the telephone connects with an electric wire. It catches the air waves made by your voice and passes them to the wire. On the electric waves the sounds travel with the speed of light to a drum-head disc in the receiver held at the ear of your friend. There the electric waves are changed back to air waves again, and your friend hears your words just as you speak them.

Isn't that wonderful?

THE GAS WE BURN

When coal was first mined in England, it was noticed that an ill-smelling gas often escaped from the seams of the coal and made miners ill. In several mines this gas was accidentally set afire and the flame could not be put out. Around such flames mine owners built brick flues and led the gas out of the mine through iron pipes. There it often burned like a torch, lighting up the mine shaft, for months and years. This gas was called the "spirit of the coal." But no one thought of trying to find out how it was made, or of making any use of it for many years.

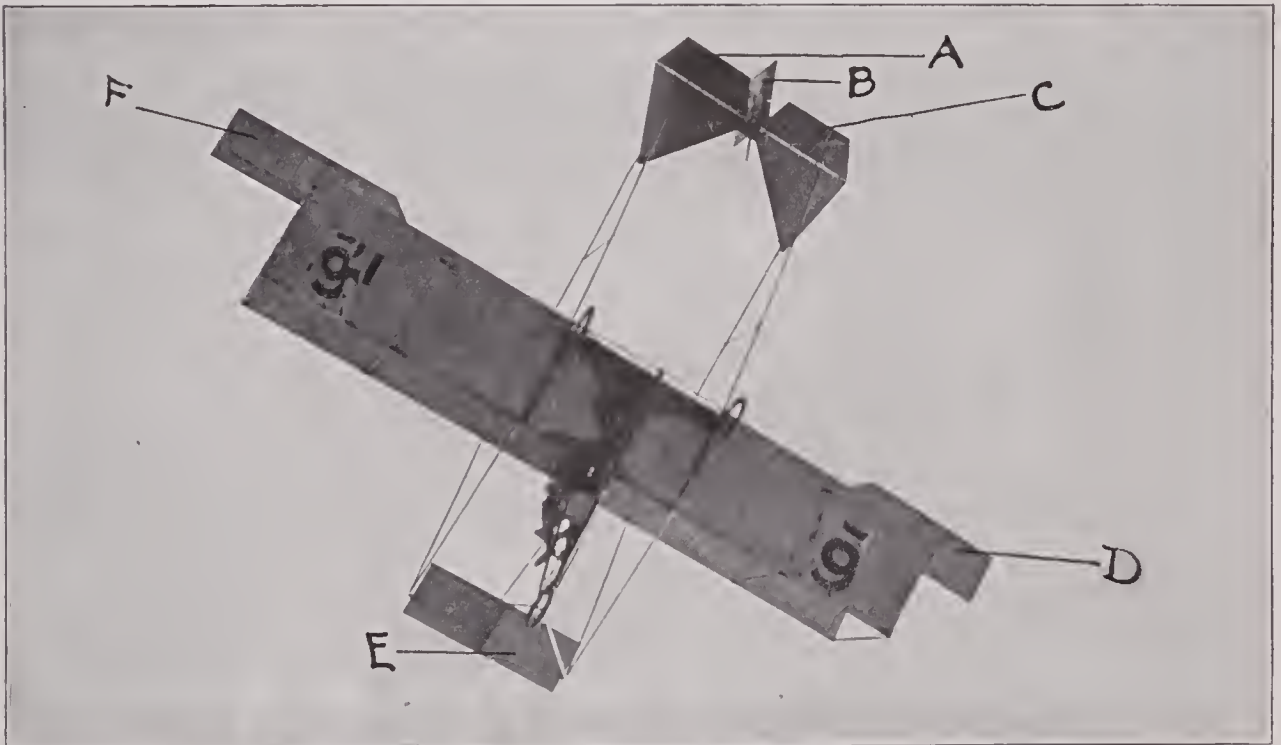
It was a Scotch miner named William Murdoch, who earned only five dollars a week, who got to thinking and experimenting with coal gas. Perhaps because he smelled the same gas from the grate fire in his cottage, sometimes, he suspected that, far down in the mine, a seam of coal must be smouldering. He filled a kettle with coal, fitted

FLYING MACHINES



Courtesy Technical World Magazine

HOW MEN FLY WITH MACHINES. You steer a flying machine with rudders very much as you steer a boat; but, as you see in this picture of the Morane monoplane, a flying machine has two kinds of rudders. One kind is for turning to the right or left, the other is for turning up or down. In this picture AA are the rudders (elevating planes they are called) for raising or lowering the machine. The vertical rudder C turns it to right or left. At first most machines had two horizontal or elevating rudders—one in the front and one in the rear. Notice the front elevators of the Wright machine in the article on Aeronautics. Now many machines, including the Wright machine, are without front elevators. Of what do the sloping planes and the elevating rudders (AA) remind you? Yes, a kite; and they raise the flying machine in the same way the kite is raised.



Courtesy Technical World Magazine

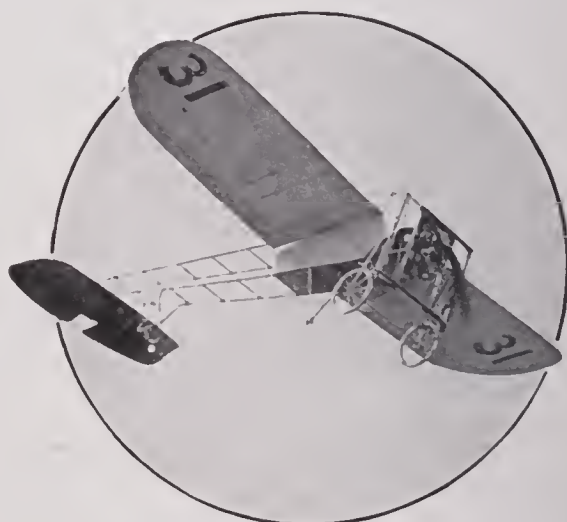
HOW THE BIRD MEN IMITATE THE HAWK. In this picture Captain Beck, of the United States Army, is "banking" (tipping) at a turn for the same reason a bicycle rider "banks" at turns on an oval track. He is using the vertical rudder B. A and C are the rear elevating rudders or planes. F and D are "ailerons." "Ailerons" are hinged sections added to the wings to help balance the machines by keeping an even keel. E is the front elevating rudder. In the Curtiss machine there is a wheel on the back frame of the seat for controlling the vertical rudder. This wheel moves as the rider's body moves and operates the ailerons just as a hawk adjusts the motions of his wings by the movement of his body when he is sailing.

All the successful monoplanes that have been tried in this country are controlled by a lever with a wheel on top like the controlling device of an automobile. But the aviator can not only turn to right or left, by "warping" the rear edges of the wings; he can, with this same lever, move the elevating planes by moving the lever forward or back. The vertical rudder is operated by a foot lever. In the Bleriot machine the engine also is controlled by this steering wheel.



Courtesy Technical World Magazine

INSIDE THE WRIGHT MACHINE. In the article on Aeronautics you see a picture of the first successful flying machine—that of the Wright brothers. This picture takes you inside of one of these machines. The radiator G which, as you see, looks very much like the radiator of an automobile, is on the side of the seat. It is placed at the side because if it should be torn loose it is less likely to fall on the operator than if it were behind him. The lever AB has two motions—one forward and back, like the lever of a locomotive—and one other motion. Notice that the handle of the lever is hinged so that it can be moved independent of the lever. With these two motions the vertical lever is turned to the right or left and the wing warping is controlled. "Warping" is like steering when you are coasting down hill. If a breeze tips up the right wing too much you work the lever and tip up the left wing to the breeze and so balance yourself. But this is likely to cause the machine to turn; so you must watch the upright rudder too. The lever C operates the horizontal rudder which is to the machine what the bird's tail is to the bird, being used to steer the machine up or down or to check speed. Have you ever noticed how a bird tips his tail down when he is getting ready to light? H is the cord for stopping the engine. To make it go faster or slower you move lever E.



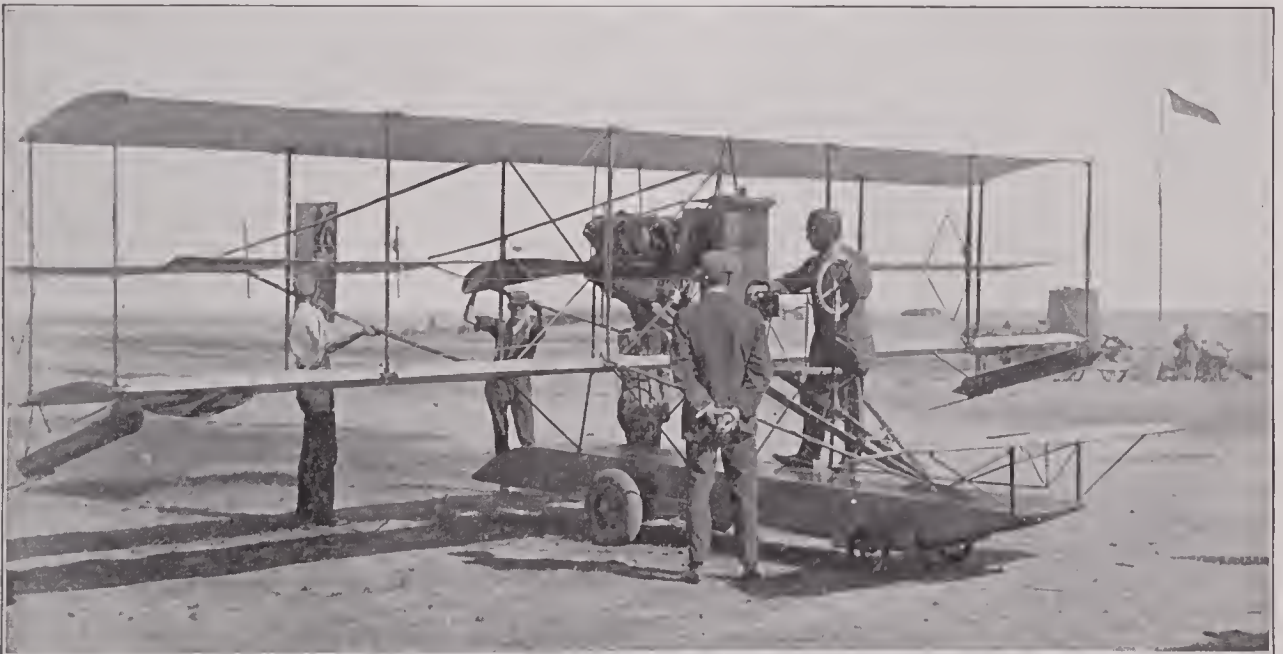
Courtesy Technical World Magazine

Tom Sopwith, the English birdman, in his Bleriot Machine at the Chicago Meet



Courtesy Technical World Magazine

THE RUDDER AND TAIL CONSTRUCTION OF THE WRIGHT MACHINE. Notice that the Wright machine has two rudders. This is intended to give a steadier control. Builders of flying machines have different ideas as to how they should be built, just as boys differ about the best way to make a kite or sled, but the Wright brothers are generally considered to have the most accurate and practical knowledge of flying machines that has yet been reached. They do not go in for sensational flying and the class of birdmen who risk their lives for records are giving way to scientific flyers and practical students of flying as an art.



Courtesy Technical World Magazine

A FLYING MACHINE THAT CAN SWIM. This mechanical bird is like a duck; it is as much at home in the water as in the air. And—would you believe it—it can light on the water, “swim” a short distance and rise again without stopping. This is just as you have seen a seagull do when he dips into the water for food. This wonderful machine can also touch the ground, run like an automobile for a short distance and rise again without stopping.

The cylinders which you see at each end of the lower plane are filled with air for keeping the machine afloat in the water. The wheels shown are not those that belong to the machine, but are part of the hauling truck.



Courtesy Technical World Magazine

AN ENGINE THAT WORKS LIKE A WHIRLIGIG. A very important thing in flying machines is to have the engine that supplies the power as light as possible. In recent years there has been perfected a type of engine known as the turbine or rotary engine. If you will look up Turbine in Vol. IV, you will see that a turbine works on the principle of a windmill; the power and motion being produced by steam driven against blades. The engine shown is called the Gnome. You can see why, for it is the most powerful machine made for its size. You know what powerful people the gnomes of fairyland are. Another great advantage of the rotary engine is that it requires but little fuel in proportion to the power produced. The type of rotary engine known as the Parsons turbine, as you learn from the article on the turbine, was first used directly on dynamos just as you see in this picture.



Courtesy Technical World Magazine

THE REAR END OF THE MORANE MONOPLANE. This picture takes you up very close where you can see all the details of the steering machinery and also the skids of one of the famous flying machines—the Morane monoplane. A monoplane is a machine with one set of wings, while a biplane has two sets of wings. The vertical rudder of the Morane is marked C and the fixed tail B. The kite-like elevating planes are shown at AA. D is the tail skid. These skids are like the runners of a sled and are to help the machine over rough ground in starting and lighting. The part of the machine here shown is called the "fuselage" or main body.

a cover of wet clay with an iron tube in it, connecting with a tank, over the kettle. Then he built a fire under the kettle to *roast*, not burn the coal. Sure enough the same yellow, smoky, ill-smelling gas came through the tube. He caught a tank full of it and corked the tube. Over the end of the tube, when he opened it, he fitted a silver thimble. In this he bored a hole. He lit the gas that escaped through the hole in the thimble and had a good light to read by. You see he had a gas storage tank, a gas pipe and a gas jet. He had everything we have today, except a key to turn his gas on and off, and he could not control the pressure so as to get a strong, steady flame, as the supply of gas in the tank lowered.

You can make gas just as William Murdoch did. Buy a clay pipe for a penny. Fill it with coal dust. Cover the top with your modelling clay, or with stiff mud. Then set the bowl of the pipe over a gas jet or on a bed of coals to get very hot. In a few minutes a yellowish smoke will come through the stem of the pipe. Touch a match to it. It will burn, but not very clearly, for it is full of smoke and other impurities.

In gas-making today, these impurities are taken out to make a colorless, smokeless gas and a clear flame. First the coal is roasted to release the gas. As fast as it escapes from the coal, it goes through pipes into big tanks, and from them is forced through water and lime to purify it. At last it goes into a gasometer, or tank, that floats with an open bottom on a well of water. The gasometer presses the gas on the water, rising and sinking according to the amount of gas inside. This keeps the pressure always the same, and forces the gas into the service pipes that run to our houses under the streets. In this way our gas pipes are kept full. So all we have to do, when we want a light, or a fire in the kitchen gas-range, is to turn a key and light, the gas at the burner.

BIRDS AND BALLOONS, KITES AND AIR SHIPS

The Chinese and Japanese people have a kite-flying day. Most of their kites are made in the shapes of birds and butterflies, with wide-spread wings. They make them of hollow bamboo, the lightest and strongest wood known, and cover them with thin, tough rice-paper or silk. Very likely, many of them think no other kind of kite could stay up in the air. But really they stay up because their weight is spread out so that a great deal of air can get under them to support them. A bar of iron rolled into a sheet and pressed into a boat floats.

If all the material in a kite were crumpled into a lump, it would sink or drop through the air. Aeroplanes or flying machines are built much like kites—light, strong and spread out, giving a great deal of surface to the air. The chief difficulty in making use of them is that they must carry an engine, and at least one man to operate them. A balloon can carry men because it is filled with a gas that makes it lighter than the air, for a time.

Now a bird is like a balloon and a kite and a flying machine. Its wings give it the surface spread of the kite. Then it has air spaces in its body, and even in its bones and feather quills, like the strong, light, hollow frame-work of bamboo. Its feather dress is as light as paper or silk. No engine ever made is as powerful, in proportion to its weight, as the living, beating heart of a bird; no propellers as strong as the bird's wing-muscles, no rudder as flexible as a bird's tail. The shape of a bird's body is that of a little boat or a fish. It is sharply pointed in front and rear, with softly curving sides. The close-lying feathers are oiled so as to offer the least resistance to the air. The legs, being of no use in flying, are light and slender, and are folded back out of the way. With its wings a bird beats the air downward.

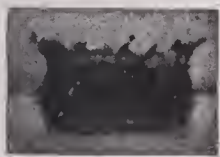
The bird knows very well that it is heavier than the air. When it wants to come down, it folds its wings and drops. Near the ground or perch, it raises its wings for a parachute, to break its fall. The aeronaut who jumps from a balloon uses a parachute. You see how much men have learned from birds in making kites, balloons and flying machines.

The first flying machines that men tried to make were really cigar or boat or bird-shaped, gas-filled balloons, with an engine to drive them in any direction through the air. That borrowed the light, air-filled body of the bird, the rudder tail and the beating-heart engine, but it made no use of the wing-power. The aeroplane or true flying machine of today, uses the wing-spread idea of the bird and the kite, with the engine heart and the rudder tail. (See AERONAUTICS.)

WHY RAIN FALLS IN DROPS

It's very lucky for us that it does. If rain fell from a cloud in a continuous stream, like a river, anyone caught under it would be drowned. There are two perfectly good reasons why rain cannot do this. The first reason is that a rain cloud is not a tank, and the

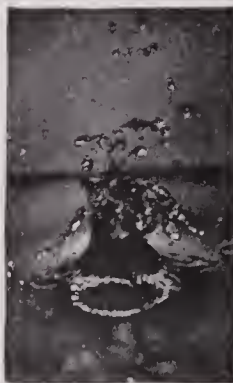
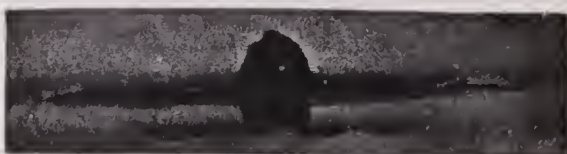
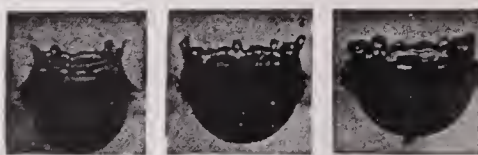
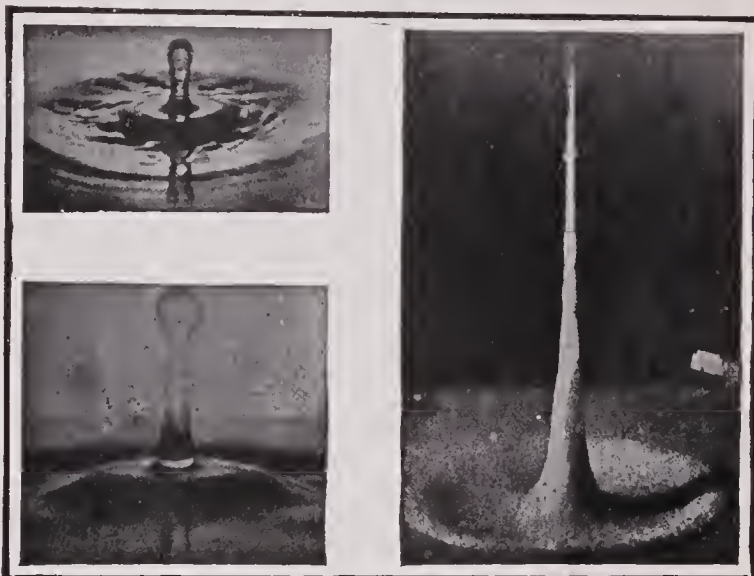
LIFE STORY OF A RAIN SPLASH



AS you have watched a rain drop falling in a pond, you have noticed how, as the drop strikes, it forms a little crater. If it was a gentle rain, you *seemed* to see a little fountain start up from the center of this crater or coronet. The next illustration shows this fountain, but there is no coronet around it. Why? The coronet disappears before the fountain starts up! The reason you *seem* to see the fountain inside the coronet is that the picture of the coronet

which is made in your eye when the drop strikes has not faded before the fountain springs up; so you *seem* to see them both at once.

Our pictures were taken by Professor A. M. Worthington, Head Master of the Royal Naval Engineering College in Davenport, England. He spent fifteen years studying rain splashes and taking their photographs. The first "splash" (upper left hand picture in group of three) is made by a rain drop falling in running water; the second in still water; the third by a pebble. The series of five next below show, in order, the different things that happen to a splash above the water; the four pictures at the bottom of the page, what happened when a rough stone was dropped twenty-two feet. The first three of these show what happened above water and the next one what happened below.



water in it is not in a liquid state. A cloud is just a great mass of vapor, in which the water is as finely divided as in fog or steam. When the cloud is blown upon by a current of cold air, the vapor runs together, turning to liquid, or the form in which we know it as water. But it cannot form a mass of water in the air, because it hasn't time before it gets so heavy that it falls. And vapor always condenses on something solid, as you can see it do on a window-pane or the outside of a pitcher of ice-water. The only solid things in the air are particles of dust. Using a grain of dust as a center of attraction, vapor condenses on it in just as big drops as the air will hold up. As that amount is very small, indeed, the vapor in a cloud falls in millions of little round drops, and each drop has a tiny grain of dust in the very center. No wonder the sky looks as if it had had its face washed after a rain!

HOW TO FIND YOUR WAY BY THE STARS

Away down in the kindergarten the little tots sing a song:

"This way's east and this way's west,
Soon I'll learn to know the rest."

They do learn, too. They learn that if one stands with the right hand pointing to the morning sun, one faces north, and the back is to the south. But they do not learn, until they are much older, and sometimes not at all, how to find the way at night. And it's worst of all to be lost at night, too.

Very high in the sky, on clear nights, is always to be seen a certain group of bright stars. There are seven stars in the group, and they make a very big dipper with a handle. Four of the stars form the flaring-bowl, two at the top, two nearer together at the bottom. The other three stars make a handle for the dipper. The last star is lower, giving a bend to the handle. Now, you must find the two stars that form the outer line of the dipper's bowl, from the top to the bottom. Imagine a straight line connecting those stars. Extend that line upward in the same direction until it runs into another bright star. That is the north, or polar star. Face toward the polar star and you will be looking almost due north. For many hundreds of years sailors guided vessels over wide seas by this polar star. So don't you think it might be useful to a lost child?

HOW THE DAYS GOT THEIR NAMES

Sunday gets its name from the Sun. In olden times many peoples worshiped the sun, the heat and light giver. The sun was believed to be the source of all life. Because they were the most wonderful and mysterious things in Nature, next to the sun, the moon and stars were worshipped as gods of lesser power. The moon was thought to be the wife of the sun, the mother of all things, as the sun was the father. The sun rode his golden chariot by day, the moon her silver chariot by night. He was everything mighty, fierce and strong; she everything gentle, beautiful and good. So the second day of the week was named for the moon goddess—Monday. Tuesday was named for the brave Norse war-god, Tyr, who made the fierce wolf a captive by sacrificing an arm. It is curious that, in French, Tuesday is called Mardi. That comes from the Greek war-god, Mars. The little fiery-red planet Mars is named after the same god. Wednesday was named for Woden or Odin, the chief god of the Norsemen. He ruled over Valhalla, the hall of the heroes slain in battle. That is the reason we keep the “d” in Wednesday. It is really Woden’s Day. Thursday was named for Thor, the Norse thunder god. He was the same as the Greek Jove, the strongest of all the gods. Jove and Thor had the cheerful habit of using thunder bolts for hammers. Friday is named for Freya, the wife of Woden and the mother of Thor. You see how fond ancient people were of families of gods. Saturday was named for Saturn, the big planet with bright moon-rings around it. The god Saturn was worshiped by the Romans and he had one special day in the week that was given to feasting and games. This celebration was called the Saturnalia. Perhaps that is why Saturday, today, is more or less of a holiday everywhere. It is as hard to break habits of whole peoples, that are fixed by many generations, as it is for a person to break a habit. You would think it something terrible to have to go to school on Saturday. Hundreds of years ago, in Rome, little boys felt the very same way about it.

HOW THE MONTHS GOT THEIR NAMES

Four of the months aren’t named. They just have numbers, but as the numbers are given in Latin, and Latin is a dead and by-gone language, their numbers pass for names, and few people are any the wiser. But we’ll begin with the first one that has a name, and that’s the very first month—January. That’s such a

good name it couldn't possibly be improved upon. The month was named for the old Roman god—Janus, the god of beginnings and endings. In statues Janus is represented with two faces. One face looks to the past, the other to the future. January first is New Year's day. Then we pay old debts and make new resolutions. We ring the old year out, the new one in.

The name February comes from a festival of purification called Februa, in honor of a god. February, in Roman cities, was the month for the cleansing of temples and houses. It has lost its meaning with us, for February is far too cold for house cleaning. March is from Mars, the war god—a noisy, blustering month with storms and wind and cold that conquer the earth over again, year after year. That's a good name, too. April comes from "aperit," a Latin word that means "open." April is the opener of the gates of birth. Her coming means the renewal of life on the earth—the awakening of the earth from winter sleep, and recovery from the wounds of wars. May is from Maia, a goddess. She was a daughter of Atlas, the god who held the earth up on his shoulders. Maia was the mother of Mercury, the messenger god who, with wings on his heels, ran errands between earth and heaven. Special honor was paid to Maia for having such a son. She, with her six sisters, was set up in the sky and turned into the seven stars that form the Pleiades; and the lovely month of May was named for her. June was named for Juno, the proud wife of the great god Jupiter.

Beginning with July the months were numbered, until two very powerful Roman emperors ruled over most of the known world. These were Julius Caesar and Augustus Caesar. Their names were given to July and August. Belief in the old pagan gods died out, and no man after the Caesars was thought great enough to be allowed to claim a month for his own. So the old numbers still stand. They are septem—seven; octem—eight; novem—nine; decem—ten. This is odd, for today these are not the seventh, eighth, ninth and tenth months but the ninth, tenth, eleventh and twelfth. When they were numbered, however, the year began with March instead of with January. So these names are not only numbers, they are the wrong numbers. But do you think we are ever likely to change them?

WHAT ARE "DOG DAYS?"

This is a very interesting question. To answer it completely one would need a book. It goes away-way back, farther than history,

into many strange beliefs of many ancient peoples. Today, by "dog days" we mean the six weeks of mid-summer from the twenty-fifth of July to the fifth of September. Then the weather is the hottest and driest, and dogs are most liable to become mad. Many peoples of very old times noticed that this heated term began about the time the brightest star in the sky rose with the sun. This star is called Sirius, which means "burning." It is in a group of stars called Canis Major. That is just Latin for Big Dog. You know many groups of stars, or constellations, are supposed to be arranged in the outlines of animals. One group is called the big bear. That is the one we know as the big dipper. One group is Taurus, the bull.

Well, Sirius, the large burning star in the "big dog" group, came to be called the dog star. In Egypt, where stars were very important in every day affairs, many things happened about the time the dog star got up with the sun. The days became the hottest and driest, the Nile river was flooded by melting snows of far-away mountains, there was much sickness, and many dogs went mad. Every one of these things was supposed to be caused by the evil powers of the dog star. The people counted time, making the year begin with the rising of Sirius. This is known in history as the Canicular, or dog-star year.

When men learned more about the stars it was discovered that it was just by accident that Sirius rose with the sun, over Egypt, at that particular time. The time of its rising, on any country, depends upon how far north that country lies, and the time grows a little later every year for all countries, owing to some forward movement, or procession of all the stars through space. In old Egypt "dog days" came in June. In early English almanacs they are recorded as beginning in the first days of July. Today, in northern countries, dog days run from late in July to early September. Sometime, centuries and centuries from now, the dog star will rise with the sun in mid-winter. Perhaps, by that time, all those stories will be forgotten, "dog days" will be no more, and little children will wonder why the burning star Sirius should ever have been called the dog star, and the group of stars in which it stands, the big dog.

WHY AN APPLE FALLS TO THE GROUND

Foolish question! You think. It falls because nothing holds it up.

Exactly. But nothing seems to pull it down, either. Why doesn't it fall up, instead of down? Ah, you never thought of that,

did you? But don't be ashamed. Great and wise men had been living on this earth of ours for thousands of years, and not one of them ever asked that question until about two hundred and fifty years ago.

One day Isaac Newton, a young man of twenty-three, who had just been graduated from Cambridge University, England, was sitting in the garden of his father's house when he saw an apple fall. "Now, what made that apple fall?" he asked himself. Very likely he remembered that the great astronomer, Galileo, had proved that a one pound and a ten pound cannon ball, dropped together from the same height, struck the earth at the same instant. So weight had nothing to do with the falling. Then, perhaps, it was because the earth *pulled* unsupported objects toward itself. But if the earth's pull was all there was to it, the heavier the object the faster it should fall. The falling object must also *pull back*. In order to pull down the heavier object, the earth must have to pull harder to overcome the stronger back pull. Everything in space must pull and be pulled, he thought, by other bodies.

But why didn't the moon fall to the earth and the earth fall into the sun, if this was so? This young man had made a great name for himself in mathematics in his college. Now he began to do sums in algebra using, for starting figures, the distance from the surface to the center of the earth, the sizes and distances of the sun and moon, and many other known measurements. Finally, he calculated, the pulling power must become weaker, as the distance between two bodies became greater. And the pulling-back power increases with the size of the object. At some point he thought these two powers must equal each other, and keep bodies suspended, unable to fall or to get away. This explained why the earth and other planets did not fall into the sun; why the smaller planets were nearest the sun; why the moon did not fall to the earth, and why all the heavenly bodies kept their places circling around the sun, and couldn't go wandering off and bumping into each other.

So the whole science of astronomy was overturned, because a college boy in a quiet country garden asked that "foolish" question about an apple, and spent years and years in working out the answer. (See GRAVITY, NEWTON.)

WHAT IS AN ECLIPSE?

Do you know the poem: "I have a little shadow that follows after me?" The little boy's shadow puzzled him. If he had only

known it, there are big shadows that puzzle grown up people. Everything in the world has a shadow that follows it, even our big earth and the moon. Sometimes we can see the shadows of the earth and the moon.

It is just like this. Did your papa ever make shadow rabbits on a wall? He lifted his folded hands between the lamp light and a wall, so that a shadow of them was thrown on the wall. Then, with his fingers and thumbs, he made a little rabbit's snub nose and twitching ears. A shadow is the same shape as the solid object that makes it. It is made only when the object gets between a bright light and a screen upon which the shadow can be thrown. Your body makes a shadow on the earth when you get between the sun's light and the earth. When the moon gets between us and the sun, the moon's shadow is thrown on the earth. That is a big, beautiful shadow! The moon hides the sun, and throws its own shadow over the half of the earth the sun happens to be shining on. The hiding of the sun is called an eclipse; the effect of it is a vast shadow on the earth that makes our sky as dark as night. You know it is always cooler in the shade or shadow of a house or tree than in the sun. In this enormous shadow of the moon the earth grows colder. Dew is formed. Flowers close their cups. Surprised chickens go to roost at midday.

There is an eclipse of the sun by the moon once a year, but most years the eclipse is only partial, and we see it only if it happens in our daytime. There is an eclipse, or hiding of the moon, once in the every twenty-eight days that it takes the moon to go around the earth. Just once, on the journey, the earth gets between the sun and the moon. Then the earth's shadow is thrown on the moon. The eclipse of the moon, too, is very seldom complete, and we do not see it at its best unless it happens at night, and when the moon is full and the sky clear. You can watch the earth's shadow pass over the moon in a total eclipse with the naked eyes. But for an eclipse of the sun you will need smoked glass or blue or gray spectacles, for all around the black, hidden center of the sun, there will appear a dazzling corona, or crown, of the sun's thick envelope of burning gases and far-thrown light rays.

WHY DOES A BEE HUM?

Hm! Hm! Let's see. A bee isn't the only thing that hums. A wheel, turning rapidly, whirs. A teakettle "sings" when the water boils. A violin string quivers with a musical note that slowly

dies away. A tuning-fork hums. A fly buzzes. All these humming, singing, whirring, buzzing sounds are made in the same way—by vibrations, or regular, rapid motions. The bee moves its wings very rapidly and regularly, when it flies—ever so many times in a second. This vibration, or trembling, sets up air waves. As you learned in the story of the telephone, sound travels on these air-waves. We can hear these sounds if they are loud enough. If the vibrations are very close together they make a continuous sound. Bird's wings beat the air, making a much louder sound than the bee, but the beats are so far apart that the sound of one dies away before the next comes. The humming bird's wings vibrate as rapidly as a bee's, so it hums like a very big bumble-bee.

WHY ONIONS MAKE YOUR EYES WATER

Your eyes really "water" a little all the time. All of our special sense organs—the tongue, the nose, the ears and eyes are kept moist by special glands. They are exposed to the air and must be kept clean. Moisture probably makes the nerves of the sense organs more sensitive to impressions. The inside of our hands and fingers, where we feel most keenly, are moister than the backs. Now, when there is trouble in a sense organ, like too strong a taste in the mouth, or a "cold" in the nose, or a grain of dust on the eye-ball, the moistening fluid just gushes out to wash it away. Then the eyes or nose or mouth "waters" or overflows.

The eye is irritated by many things beside dust. The fumes of vinegar, pepper and onions make the eyeballs smart. Instantly the tear-glands overflow to protect the eyes. If they could not do this the eyes would become inflamed, and they might be permanently injured. Just watch now and see if onions and pepper do not make you sneeze, and make your nose "water," too, as well as your eyes. Think of lemons and feel your mouth "water."

WHY WE COUNT BY TENS

We count by tens because we have ten fingers—five on each hand. Nature is very fond of counting by fives. Five fingers on each hand; five toes on each foot; five petals in an apple blossom; five rays in a star-fish. In the Story of Life you will find a whole chapter on how nature counts in making the parts of plants and animals. When men became bright enough to want to count, they

counted on their fingers, because they always had those ten little counters with them. Children count in that way at first, and it is several years before they can *think* numbers inside their curly heads, without using these lively little counters. Here is a curious thing. Men got so very, very wise after awhile that they thought they could improve on nature's way of counting. In England the money system is all mixed up. A penny is two cents; a sixpence, twelve cents; a shilling, twenty-four cents; a crown, two and a half shillings, or sixty cents; a pound, twenty shillings, or four dollars and eighty cents. You see your fingers don't help you a bit. Measurements are made by twelve inches in a foot, three feet in a yard, and so on up to acres of land. Milk is measured by pints, quarts and gallons. English "tables" are terrible things to learn in school, and there is really no rule or sense in them.

In America we use these English tables, except for money. There we go back to nature's tens. Ten cents one dime, ten dimes one dollar, ten hundreds one thousand, and so on. A "nickel" is half a dime, or five cents, the same as the pink fingers baby learns to count with. In France everything—money, land, potatoes, ribbon, gold at the jeweller's, quinine at the drug store, gas out of a pipe, is measured and counted by tens. This is called the metric system. Already this French metric system is used by scientific men, and it is thought, some day, as the peoples of the earth travel and trade more and more, we will all adopt this way of counting and measuring everything. So you see, it is pretty hard for men to be wiser than old Mother Nature.

WHY DOES IRON RUST?

When you grow up and are very, very wise you will not say that iron rusts. You will say it becomes oxidized. That means that the surface of the iron is burnt by the oxygen of the air. Rust is really an iron ash. You can rub old rust off in a powder as fine as ashes. These iron ashes mix with the soil, giving it its good brown or red color. They dissolve in water, are taken up by plants and used to make their green color. Finally, through water and plants, we take iron into our bodies to give us the red color of our blood.

Isn't it a fine thing that iron can rust, or be burnt to a red ash by the oxygen of the air. Gold and silver do not rust, and so they are called the noble metals. But John Ruskin, a great English writer who thought the most *useful* things and men the noblest, said of

iron: "It breathes the air, burns itself up in oxygen, and so gives its own life that we may live." If you see a rusty tack or nail, push it into the earth. It might give you a dangerous wound. But the earth can make the noblest use of it, and give it back to us in rippling grass and beating hearts.

WHAT MAKES WATER BOIL?

I'll read you your riddle, if you'll read mine?

When is water not water?

When it's ice or vapor!

Right. Water is very uncertain. Most of the time it is a liquid. But if it gets too cold it turns into a solid. If it gets too hot—whisk! It is gone into the air! When it has vanished it is vapor, or water gas. Now air is a gas. The light you read by is made by burning coal gas. You cannot see a gas at all. So you cannot see vapor, or water gas. Needing a great deal more room as gas than it did as a liquid, water expands, or explodes, if confined in a kettle. This makes bubbles. We say the water boils. It will go on boiling, or expanding into bubbles, until the water all boils away, or escapes in gas, if the kettle is left over the fire.

Here is a funny thing. If you boil water over a camp fire on the sea shore, you have to heat it to two hundred and twelve degrees. But on a mountain top, water boils before it gets as hot as that. This is because, on low ground, there is more air above the water than on land a mile or two higher. The lighter the air pressure the easier it is for water to expand into gas. Therefore, it takes less heat on a high mountain to make water boil. Of course, then, boiling water away up on the Alps isn't nearly as hot as boiling water on a sea beach. In some very high places boiling water should be just about right for a warm bath, and water there would escape in gas long before it was hot enough to boil an egg.

WHY AN IRON SHIP FLOATS

If you put a nail or a lump of iron in a vessel of water it sinks at once. A piece of wood of the same size floats. So, until fifty years or so ago, people thought all boats and ships must be built of wood, or they would sink.

Take a sheet-iron pan from the kitchen and put that on the water. It floats. It weighs just as much as the lump of iron that sinks, but the weight is spread or distributed over a larger volume

of water. That is all. It has been made lighter than the total amount of water it rests upon. A ship is just such a hollow vessel, whether made of iron or wood. When there is nothing in it, a ship stands high, almost on the surface of the water. As it is loaded with goods and people, it rides deeper. Load your sheet iron pan with a cargo of toys. Watch it go deeper. Don't fill it to the top. That would make it as heavy as if it were solid. Then it would sink.

If you live in a lake or sea-port town, you will find that all ships have a water-line painted plainly around the hull. This is the safety loading line. No ship owners are allowed to load a vessel so heavily that that water line sinks below the surface of the water. Air spaces must be left, to keep the ship and its cargo lighter than the water that is beneath them. In the old days overloaded wooden vessels often sank. Today, iron ships ride the ocean safely.

WHY WE HAVE TWO EYES

Have you a stereoscope with views? The views show two photographs, almost alike, mounted side by side on the same card. Yet when you look at them through the lens of the stereoscope, you see but one picture. And that picture stands out, or is, as we say, "in relief." In an ordinary photograph everything appears flat. In stereoscopic views the solid appearance of things, with depth, distance, or perspective, is brought out as in life. That is because the ordinary camera has but one eye, or lens. The stereoscopic camera has two lenses, and takes two views, as far apart as a pair of human eyes. You see but one picture, exactly as you would have seen the real view with your two eyes. If you examine them very closely you will see that the two views, are not exactly alike. One shows more detail on the right outer edge, the other on the left. Look at something with both eyes. Close one eye. At that end the object you look at is blurred. Open that eye and close the other. The object is blurred at the other end. When we look at things, we really get two images from two points of view, as we say. The brain focuses these images as the stereoscope lens does, and brings them together into one view. In this way we see solid, or "in relief," so we judge of size, location, distance, solidity, color, and many other things better than if we had but one eye.

ALVA AND HIS WONDERFUL LAMP

Is your house lighted by electricity? Did you ever stop to think that every other kind of light—of a candle, an oil lamp, or of gas,

must have the oxygen of the air to feed the flame. But in an electric lamp there is no opening for air. The light is made in a vacuum, or closed place, with no air in it. And the light is not made by a flame at all. It is made by an electric current passing along a loop of carbon filament as fine as a hair. It looks like pure magic, just as when Aladdin rubbed his lamp and did such wonderful things. A boy named Alva just rubbed his head, and did some wonderful thinking to make the electric lamp.

Of course he knew about the electric arc-lamp that was invented long before he was born, and that was in use to light our streets when he was a young man. The arc-lamp has two thick carbon pencils with the points nearly meeting. An electric current running along a wire, and to the end of one of the pencils jumps to the other pencil carrying some carbon dust along for a bridge. This electric bridge, in burning carbon dust and oxygen of the air, gives a dazzling white light. But it burns the oxygen rapidly, and is, in many ways, unfit for indoor use.

It seemed to our boy that as an electric flash is not a flame, a light should be made to pass over a carbon filament bridge in an air-tight lamp, so as not to burn up the oxygen we need to breathe. The trouble was to find a material for a small lamp, to take the place of the carbon pencils in the arc-light. He tried a hundred different things—platinum, cotton, bamboo and many others—and treated them in many ways. Some were too expensive, burning away too fast, even in a vacuum; some too frail. At last the perfect filament was made. Then how was the electric current to be carried to the filament inside an air-tight lamp?

The filament ends were set in platinum wires into the solid neck of the lamp, that was made to screw into a socket. The snapping on and off of a button on the socket, connected and disconnected the platinum wires with the copper wires that carry the electric current into the house. But don't you wonder how the filament is put into the closed glass bulb? When it is made the bulb is left open at the tip, where there is always a little knob or point. When the wires and the filament ends are set in the neck, the end of the bulb is heated, until the glass is soft. Then the air is sucked out making a vacuum, the tip is squeezed together, and there is the magic loop of light shut up in an airless, crystal prison. (See EDISON, ELECTRICITY.)

WHAT KEEPS A TRAIN OF CARS ON THE RAILS?

A great many boys will think they know the answer to that. They will say it is because of the rim, or flange, that is on the inside edge of the car wheel. That rim merely steadies the car—keeps it running smoothly. But notice the next time you go to the railway station, that the rail is not flat on top. It is slightly rounded. If a freight car is standing on a side track you will see that the rim of the car wheel is not flat, either, and it does not rest squarely on the top of the rail. Beside having a ring-like flange on the inner edge, the broad rim of the wheel slants much like a cork that is made smaller at one end so it can be pushed only part way into a bottle. The outer circumference of a car wheel is smaller than the inner. And the wheel rests on the inner slope of the rounded rail.

In running, the wheels press outward. That is, the wheels opposite each other push outward or away from each other. This is because it is easier for them to run along the smallest edge, and on top of the rail. By pushing outward, with the same force in opposite directions, they keep each other balanced and on the rails.

WHY MILK TURNS SOUR

You know milk turns sour when it is a day old, sometimes. But you can buy milk that is a year old, or more, that is just as sweet as it was when it came from the cow. It is condensed, or evaporated milk, sealed in air-tight tins. When the can is opened the milk in it will soon turn sour. That is because it is exposed to the air. The air is full of microbes, or little living plant cells like yeast and mould. They are too small for you to see. Like all plants they need soil to grow in. The soil they like best is a liquid with sugar or starch in it like milk, fruit juices and flour batters. In growing, these tiny plants change sugar and starch to acids. So milk becomes sour and fruit juices ferment. After a time the fruit juices stop fermenting and turn to vinegar or wine. But because milk is an animal product it decays.

If milk is cooled quickly, and kept on ice, the microbes find it much harder to live and multiply in it. Iced milk can be kept sweet for two or three days. It can be kept still longer if it is first heated in a corked bottle to a temperature that kills the microbes, then cooled quickly. This is called *Pasteurizing*. In cities, people have to *Pasteurize* milk to make it safe for babies. In evaporating, or

condensing milk, the milk is heated in steam tanks to the boiling point, and kept there until most of the water passes off in vapor. Then it is sealed, boiling hot, in air-tight tins. Milk is a favorite food of many little plant and animal cells that harm us if we drink them. So, to keep as many of them out as possible, cows should be healthy, and stables and milkmen clean. All pails and strainers and bottles used should be boiled. The milk should go into the bottles as quickly as possible, be sealed up with waxed paper caps, cooled and shipped at once. The ice box must be kept clean, and the bottles sealed until the milk is wanted. Never allow milk to stand in a warm place, or in an open vessel. If you do, millions of microbes will move right in and begin to grow.

CHILDREN, BIRDS AND TEAKETTLES

Guess why they are alike. They all sing. They all sing in much the same way, too.

Watch very close and find out how you sing. You fill your lungs with air. Then you nearly close your throat and *force* the air out through a small opening. As the air goes out, it presses on the cords in your voice box and sets them to trembling, or vibrating like violin strings. A bird sings in the same way. Now watch the kettle. The kettle is full of water and air. Don't forget the air. When the water begins to boil it turns into vapor, or water gas, by exploding into bubbles. Vapor needs more room than water. So the first thing the vapor in the kettle does is to force the air out through the spout of the kettle. That is just like the narrow opening in your throat. Then the vapor keeps coming out in such rapid little explosions that the kettle vibrates. That makes the singing. Sometimes it "sings," or vibrates, so forcibly, that the lid of the kettle dances, keeping time like castanets.

WATER AND A DUCK'S BACK

What is quite so wretched looking as a wet hen? She is drenched by a hard rain just as quickly as you are. But you never saw a wet duck, did you? Yet a duck spends most of its life swimming in ponds. It dives for food and comes up as dry as bone. The feathers do not account for this, for the duck's feathers are not so very different from the chicken's. The secret of it is that the duck's feathers are oiled. There is an oil-making gland on the duck's back near the

tail. The duck spreads a film of this oil all over the surface of its feathers. Now oil and water will not mix, so the water cannot get through this oil to wet the duck's feathers. Besides, the oil slips past the water, making swimming easier. The next time you go swimming oil your back and the water will roll from it just as it does from a duck's back.

WHY FROZEN WATER BURSTS PIPES

Nearly everything we know is expanded or swollen by heat, and contracted or shrunk by cold. But water is queer. It's particles huddle closest together, and fill the smallest amount of space when in a liquid state. And it is expanded by both heat and cold. When heated to the boiling point and turned into vapor it takes up the most space. Steam confined in a boiler bursts iron walls, if it can get out in no other way. So in freezing, water expands to a larger bulk. That is why ice floats in water. If the water happens to freeze in a pipe, where there is no room for it to expand, it bursts the pipe. Some people think the thawing bursts the pipe, but the thawing only shows us the places where the frost burst it. You know a quiet pond freezes more quickly than a running stream. One way to keep your pipes from bursting in zero weather, is to open a faucet a little way. That keeps the water flowing so it is less likely to freeze.

WHY WE ARE TANNED BY THE SUN

"To tan" has two meanings. One is to turn anything a yellowish-brown color. The other meaning is to toughen and harden skins into leather. In the making of leather, both the toughening and the coloring are results of the processes of tanning. So it seems to be in the case of exposure of our skins to a great deal of hot sunshine. When a city child, who has lived in the house and in shaded streets, goes on a vacation to a farm or the seashore in mid-summer, the first effect of the exposure to sun rays is burning of the tender skin. This would not do at all, for burned skin blisters and peels. Different things in our bodies always rush to any injured parts to heal and protect them. A dark surface absorbs heat better than a light one. So to protect the skin from the heat, a dark pigment or paint is formed by blood cells and sunbeams acting together. This not only darkens the skin but toughens it, too. Our skins are really "tanned" some-

thing like leather. Do you see why brown and black people are natives of hot countries where there is much sunshine, while the fairest nations of the white race live in cold, northern countries where there is the least sunlight?

WHY AND HOW WE GO TO SLEEP

"Why do we go to sleep?" That is what the little "why" boy asked his mama.

"Because we are sleepy."

"Why do we get sleepy?"

"Because we are tired."

"But why do we get tired?"

"Oh, dear!" The little boy's mama said she never knew such a tiresome child for asking questions. He made her so tired she was sleepy. Now what had happened to her?

We all have two kinds of nerves. One kind makes us feel, see, hear, touch and taste. Their tiny, sensitive ends come to the surface all over us, and telegraph sensations to the brain. The brain telegraphs to the nerves of motion to make the body do things. When they are used all day long, these sensation and motor nerves get tired of sending messages. The brain gets tired of receiving them and sending orders. The muscles and bones of the body get tired of carrying out these orders.

You see, everything is made tired, or worn out by use—just as your shoes are. You have to throw a pair of tired-out shoes away. You cannot do that with your body. But it will make itself as good as new, if you give it a rest every so often. In sleep the wearing out is stopped. The nerves and brain—which is a big bundle of nerves, a switch-board for "central"—the muscles and bones all stop working. The heart, lungs, stomach, and all food-making organs, go right on working, although not as rapidly as when we are awake. The fires of life burn low. So the day's waste is made up, and we awake rested.

While grown people rest when asleep, children both rest and do most of their growing. Children need more sleep than grown people. Children who have too little sleep are apt to be small and weak, and not as bright in their minds as they might be. But *how* do we go to sleep?

By shutting all the little doors to the brain. Nature begins it. At the end of a day, we do not feel, hear or see as keenly as when we

are fresh in the morning. The nerves do not carry messages as rapidly, nor the brain or body act as quickly. Then *we* help nature. We undress and lie down in the dark. We protect all the little surface nerves from sensations—try to give them no messages to carry. We shut our eyes for the same reason, and we make the house quiet to keep sounds from knocking at our ears. With no “ringing up” on the switch-board, much of the blood leaves the brain. The heart and lungs slow down, the stomach will not need food-fuel for twelve hours or more. So we go to sleep. Now some little “why” boy is sure to ask;

“*Where* do we go when we go to sleep?”

We don't go anywhere. When we dream we go to places, it is because the outside world isn't quite shut out, or an overloaded stomach telegraphs trouble to the brain. We aren't as fast asleep as we should be when we dream. The best kind of sleep is when we are all there and don't know it.

THE AGES OF ANIMALS

No one knows exactly how long animals live in a wild state, but records have been kept of animals that have been tamed by men. And scientists are able to come very close to the ages of wild animals by examining the teeth, bones and other parts of the body. Turtles, toads, crocodiles and many reptiles, all cold-blooded animals, have the longest life of land animals, some living up to three hundred years. The elephant is thought to live about one hundred years. Whales live five hundred years, and scientists think some may live to be a thousand years old. Domesticated animals are short lived. A dog is old at twelve, and dies at fifteen. A few have been known to live, but blind and feeble, until twenty. Cats live from thirteen to fifteen years. The wild cats, or lions, live to be forty. Horses and cows are old at twenty, and die before thirty. Of all birds the little singers are the shortest lived, living from three to fifteen years. This may be because of the many accidents that cut their lives short, for pet canaries have lived for twenty-five years. The crow, swan and eagle often live to be a hundred. With a few exceptions, the rule seems to be that the largest animals of all classes, those of which there are fewest in number, live the longest. The same rule seems to apply to plants. There were big trees in California, and whales in the ocean, that were hundreds of years old when Columbus discovered America.

WHY BEARS LIVE ALL WINTER WITHOUT EATING

One-half of the answer to this is: As bears sleep most of the time in a warm place in winter, they do not need as much food as when they are active. The other half is that they eat themselves. In the summer months they eat greedily, a great deal more than they need at the time. This extra food is stored up in their bodies in thick layers of fat. This fat keeps the sleeping bear warm. Food is fuel. As he is very warm in his blanket of fat, a bear needs less food. And, gradually, he eats the blanket. The fat is absorbed into the blood to feed all the other tissues of the body. In the spring the bear comes out thin and poor.

Many other animals hibernate in the winter. Snakes store up fat to live on. You see there is little food for them in winter, so Nature taught them how to stock up their internal pantry shelves for hard times. When you are sick and can not eat as much as usual, you, too, live partly on the fat stored in the body. That is why you become very thin. And that is why, when you begin to get well, you are as "hungry as a bear."

WHY IS THE SKY BLUE?

That is a hard question! But it isn't a foolish one, by any means. It was only about fifty years ago that a great English scientist named John Tyndall worked out the puzzle. See if you can understand the answer.

The sun is 92,897,000 miles away from us, but the sun's white rays come to us straight, with no interference, until they strike the earth's atmosphere about forty miles above our heads. This atmosphere absorbs, or swallows up the light rays. If this were all the sun should look to us like a great star, and the sky at midday should appear dark and clear as on a winter night, with all the stars shining. Long ago scientists noticed that on very high snow-covered mountains, and out in mid-ocean where the air is purest, the sky is darker than it is over low land. The air near the earth, that is heavy enough to be breathed, is full of fine earth-dust. These dust particles catch and break up the light rays, just as a glass prism, or a diamond breaks a ray of white light up into rainbow colors. Now if all those rays could get through to us we would have a rainbow sky. But the impurities are of just the right size and number to throw back all the other colored rays, and to reflect the blue rays to us.

So of all the sun's light, we get only the blue rays reflected from the little dust mirrors in our own atmosphere. A blue sky is the very nicest kind of sky for us. If there were no impurities, or dust, in our atmosphere it would be so dark we couldn't see very well. And if the impurities were of a different size or number, we would have a red or a yellow sky. Either one would dazzle our eyes. Now, when our sky is gray it is because the earth dust is coated with vapor or water dust, making clouds. Vapor is not as good a reflector as dust, so we do not get our blue light until after the vapor has condensed and fallen in rain. (See SUN, TYNDALL, SPECTRUM.)

WHY THE SKY IS MANY COLORED AT SUNSET

You can't imagine a rainbow-colored sky!

Oh, yes, you can. Haven't you seen the brilliant colors of sunset? When the sun is above us, at noon, the light rays come straight down to us, or at a slight slant through the atmosphere. Then we get the reflection of the blue rays, only. But when the light comes to us in level lines along the surface of the earth at sunset, the rays pass through a thicker layer of smoke and dust. From more impurities of more varied sizes and greater densities, the red and yellow rays are reflected, as well as the blue. Some dust particles combine reflections, giving us green, orange and violet lights. At sunrise the same thing happens, but, for some reason, the colors of dawn are usually more delicate and transparent than at twilight.

Sometimes the *amount* of dust in the air is greater than at others. Volcanoes have been known to throw columns of ashes or volcanic dust into the sky as high as two miles. This dust is carried on the upper currents of air to great distances. It is even thought that it sometimes forms a belt entirely around the earth. After days and weeks all this great volume of volcanic dust settles, or is washed out of the air by rain. But while it is in the air we have a series of very fine sunsets and sunrises.

SOUND WAVES AND THE PHONOGRAPH

You remember how, in the telephone, the sound waves made by the voice are caught on an iron disc, or drumhead, and sent on to the wire. Now phone means sound and graph means write. In the phonograph the sound waves of the voice are caught by a drumhead and made to shake a needle that moves over a rolling cylinder,

and scratches or writes upon it. Thus a record is made of a dictated letter, a speech or a song. When the cylinder is put into the machine and the needle made to move over the same marks the sounds recorded on the roll are repeated. The sounds are magnified in a trumpet, and so made loud enough to be heard by our ears. On a phonograph record-roll you can see the faint, irregular line made by the needle. A given sound always makes the same kind of mark. Of course, then, it must always give back the same sound.

HOW DOES SOAP TAKE OUT DIRT?

You can find out the answer to this by making a little soap in a greasy frying pan. Put a very little water and a big spoon full of washing (lump) soda in it, and let them boil together. You get a thick soft soap. The grease is broken up and mixed with the soda, and the frying pan is cleaned. Our grandmothers made great kettles full of soft, brown soap by boiling waste fat and wood ashes lye together. Lye, soda and potash, or what are called the alkalies, break up and dissolve the fats. Our skin makes a kind of oil all the time. This oil gathers dust, and makes us and our clothing dirty. We can cut this dusty oil from the skin with soda or some other alkali, dissolved in water. But an alkali is so strong it dries out and breaks up the skin as well as the oil. So we weaken the alkali with other oils or fats first. There is still an excess of alkali in the soap called "free" alkali, enough to take up the oil in our skins and clothing without injuring them. Of course, with the oil comes the dust. If your face smarts or shines after a scrubbing with soap, it is probably because the kind of soap you use has too much "free" alkali in it for your skin. Or the water is hard and does not dissolve the soap properly. As waters and surfaces to be cleaned differ so much, many kinds of soap are necessary.

WHAT IS THE HORIZON?

The horizon is the boundary of as much of the world as you can see from the place in which you happen to be standing. If you are on the ocean, or on a flat plain with no houses or trees to break the line, the horizon is a perfect circle, because you are able to see the same distance in every direction. The horizon, then, is the circular line where the earth and sky seem to meet. The distance that can be swept by the human eye, depends upon the height from

which the view of the world is taken. On the sea, or a plain, a man with perfect eyes can see a distance of about two and a half miles on a clear day. That is, he sees across a circle of five miles, or around a horizon of about sixteen miles. From a sky-scraper tower, two hundred feet above the earth, the same man can see nearly nineteen miles. From a mountain five thousand two hundred and eighty feet, or a mile high, he can see nearly one hundred miles in every direction. We can see farther by going up higher, because the earth is a sphere, or globe. The surface of it slopes away on all sides. At a certain distance, on a level, the slope falls below our vision. As we go higher, farther limits come up within range of our eyes.

WHY THE EDGES OF COINS ARE "MILLED"

Have you a silver dollar, or a gold piece? Your papa has. Perhaps you never noticed that coins are cut in regular up and down grooves around the edges. This is called "milling," because it is done in the government money mill, or mint. Coins have been milled for so long a time by all countries, that no one knows just when the practice was begun. But the reason for it is very well known. Dishonest people used to shave away thin layers from the edges of coins. When the edges were smooth this could be done, and no one could detect the theft unless the coins were weighed. When the edge is grooved or milled, stealing in that way is not so easy. New grooves, as regularly spaced and as evenly cut, could not be made again, except by melting and re-minting the coin. Copper pennies and nickels are not milled, for the metal in them is not valuable enough to pay any one for the trouble of shaving the edges away.

HOW TRAINS RUN AROUND CURVES

The first law of motion, as you learned in what keeps a bicycle upright, is that a moving thing goes forward in a straight line. If the direction of the moving is changed some other force must come into play. What force will interfere with a forward movement on a level? Why a rise in the level. It is harder to go up hill. To make a little hill the outside rail is raised quite a little higher than the inside rail. The height to which the outside rail needs to be raised depends upon the sharpness of the curve, and the speed at which trains are expected to run around it. Around very sharp curves trains must "slow down" to keep from running off the track. When you run around a corner, or ride around one on a bicycle, you lean

toward the inside of the curve. Horses do this, too. Just take notice and see if this isn't true.

WHERE OIL COMES FROM

Oil is made by animals and plants. The flesh of all animals contain fat that is easily melted into oils. Mutton fat or tallow is so waxy that it hardens and makes good candles. Whales have a great blanket or thick layer of fat that men used to melt and burn in lamps. Codfish give a very pure, rich oil that is valuable as a food-medicine for building up sick people. Among plants the olive is best known for its oil, but peanuts, other nuts, cotton seed, castor beans, and many other fruits and seeds are rich in oil. When men first found petroleum far down in the earth, they called it mineral, rock or coal oil. Now we know that there is no such thing as mineral oil. We know that coal and coal oil are both vegetable products. The plants that were pressed into coal beds contained oil, probably in the fruits or seeds. Under pressure, the oil escaped from the woody cells, and collected into pockets or wells in the earth in enormous quantities. Much of the oil in the earth has been vaporized, or turned into gas. This accounts for natural gas.

WHAT KEEPS A BICYCLE UPRIGHT

Motion. A bicycle keeps upright only as long as it is moving. When standing still it has to be supported against something. It seems rather odd that the bicycle wasn't invented long before our day. Newton, the same great thinker who discovered the law of falling bodies, and separated rays of white light into the colors of the spectrum, also discovered certain laws of motion. Of all the laws of motion he placed this first: "A moving thing will move at a constant speed, and in the same straight line forever, unless some other force stops it." Every child who rolls a hoop uses that law. He sets the hoop moving in a straight line. The earth pulls the hoop over as soon as the force that set it in motion becomes weaker than the earth's pull. In the bicycle, the rider constantly applies new force to the wheels through the pedals, and so keeps the wheels rolling forward.

THE MAN IN THE MOON

There is no man in the moon, for the moon is an airless, waterless, dead world. There is no life on it at all. And if there were men there, the moon is so far away we could not see them. Besides,

the man's face that we sometimes see, covers the whole, round, bright surface in a good-natured smile thousands of miles wide. That would be a giant! This face is made by the shadows of great mountain ranges, by sunken beds of dried up oceans, and the deep holes of dead volcano craters. It is curious that these hills and holes and shadows should be so placed as to look like a vast face. If you look at the moon through a telescope, or even an opera or field glass, the face disappears, but the things that cause the shines and shadows come out very plainly. Often you can see the mountains on the moon best when it is not full. They stand out, making a jagged or wavy line along the inner edge of the crescent. Astronomers have made maps of the surface of the moon. Knowing the size of the moon, they are able to measure the heights of the mountains by the lengths of the shadows that are cast by them.

WHY BIRDS MOULT

Birds moult, or drop their feathers and grow new ones once a year or, in some kinds twice, for the same reason that you buy new suits of clothes. Feathers wear out. They get dirty and ragged from hard wear in all kinds of weather. Then they do not protect the bird's skin as well, keep him as healthy, or present as smooth a surface against the wind for flying. All animals moult, some only while growing, some at changing seasons. Fur-bearing animals, horses, cattle, dogs and cats grow thicker coats in winter and shed them in the spring. Snakes, crabs, lobsters and other animals shed their skins because they outgrow them. You shed your skin, but a little at a time, in tiny scales. You can see dead skin roll up when you rub yourself hard after a bath. You shed your hair, too. Old hairs fall out nearly every day, and new baby hairs grow in their places.

WHY PEOPLE BECOME SEASICK

As human beings are land animals their bodies are fitted to live on a stationary base. The sea is always in motion. Anything floating on a big body of water is constantly lifted and let fall and tilted at many angles. This disturbs the nerves of the eyes and the balance or equilibrium of the body, producing dizziness in the head and "sickness" in the stomach. It is probable, too, that the contents of the stomach are more or less shaken by the motion. Many people become just as "seasick" on rocking railway trains as on boats. And

TAKES PICTURES

ON THE WING

IN Germany carrier pigeons have been used to get "birdseye" views with cameras. The camera is strapped to the bird's breast, and is made so that it points downward when the little photographer is on the wing and catches whatever he may be passing over when



the film is exposed. An automatic (self-working) device, wound up like a watch, exposes a new film at regular intervals. From the two examples given at the bottom of this page you can see how the world looks to a bird or to a man in a flying machine.



This shows how the camera is strapped to the breast of the feathered artist. On the right is the dovecote on wheels. His owner sleeps below.



Here are views of Emperor Frederick's park, which the public is not allowed to enter, and of a portion of a village both of which were taken by "pigeon photography."

some cannot even bear the motions of swings and hammocks. But people differ very widely. Some are never made sick at sea, and others never get over the tendency, no matter how much they travel. Children rarely suffer from this malady. That is probably because they tumble about more than do grown people. It doesn't bother an active boy much to have his stomach rocked, or even turned upside down.

HOW A CAMERA TAKES A PHOTOGRAPH

Of all machines a camera is the Chinaman. It does everything upside down, wrong side before, and right side out. Then the eyes in our heads are Chinamen, too, for they are Nature's cameras. Camera means a room, or chamber. Men who are very exact say *camera obscura*. That means dark room. The camera and the eye each have a dark room. In front of this dark room is a small, clear, thick window, or lens, for letting the light rays through. At the back of the room is a screen on which the picture is thrown, just as a screen is used in the moving-picture show. Look at the lenses of grandmother's spectacles. They are oval bits of glass, thickest in the middle. Through them grandmother can see the widest landscape and the highest sky. The light rays, falling at widely separated angles, almost meet in the tiny lenses. As they pass through the lenses they do meet in points just behind them. The rays cross each other where they meet, and spread again. But as each ray travels straight, the upper rays fall below, after crossing, and the lower rays rise to the top. That turns the picture upside down on the screen at the back of the dark room. Look into a camera and you will see the picture upside down. A photographer just turns the plate around. In your eye the optic nerve, or the brain, turns the picture right side up.

But how is this topsy-turvy picture fixed on the screen at all? The screen in the camera is a glass plate, or a gelatine film. This is coated with a sensitive chemical that is acted upon by light rays. Every gradation of light, from pure white to dead black, acts upon it differently. Rays from a white collar destroy this chemical; black cloth, giving off no rays, do not act upon it at all. The picture you get is not only upside down, it is a negative. Negative means "no." That is, it is the "no" or the very opposite of the thing pictured. In the negative, the white collar appears black. But the negative prints a positive or "yes" on a dark paper sensitive to light rays.

Sunlight, falling through the negative, bleaches the paper back of it to a true picture of the original subject. A photograph is made in the same way as the picture in your eye. Both are made by the light of the sun.

DON'T PUT BOILING WATER IN A COLD GLASS

If you do—crack! You may break it. If the glass is thick it is almost sure to crack. The thinner the glass the smaller the risk. That's odd, isn't it? Why is this? Heat expands. When a thing expands it needs more room. Glass expands readily. If it is thin the heat goes through quickly, expanding all parts alike. But when the glass is thick, the inside particles expand before the outside becomes heated. So the cold outside layer has to crack to give the warm inside layer room to expand. The same thing happens, sometimes, in pouring hot coffee into a cold cup. If you put a silver spoon in your glass or cup it will be less liable to be cracked. The metal attracts the first heat, and allows the glass or china time to heat more slowly and evenly. And a glass or china cup is apt to be cracked if it is very hot and you put ice water in it. Cold contracts or shrinks the glass. So the inside shrinks while the outside is still stretched.

WHY SALT MAKES US THIRSTY

We need salt in our bodies to keep us healthy. Our blood is just about as salty as sea-water. Isn't that curious when we think that animal life began on our earth in the sea? Now salt melts or dissolves easily in water, and in our blood, until they become brine. If we eat salty food the body soon gets too much salt in it. The only way to get rid of it is to dilute it with water. When the body needs water it very promptly calls for it. We say we feel thirsty. Salt isn't the only thing that makes us thirsty. Sugar, and many strong, hot spices heat the blood and need to be diluted with water and washed out.

WHAT MAKES A LOCOMOTIVE GO?

An engineer would tell you that a locomotive is driven by steam power. He understands what that means, but you don't. So that is no answer for you. You know what steam is, of course. It is vapor, or water turned to a gas by heat. In turning into gas it expands, or takes up more room. What a fuss steam makes to get out of a teakettle! If you cork the spout, the steam pushes up the

lid—fairly makes it dance. So you can easily see that steam is strong enough to do a good deal of work. It is stronger than you imagine. If you seal a kettle air-tight, so no steam can escape, and let the water go right on boiling, by and by the kettle bursts into little pieces. That gas *must* have more room. Each tiny atom of that gas is a little hammer that flies around and beats on the walls that hold it in. It hasn't much power alone, but when there are billions of these hammers, all battering at one wall, something has to give way.

An iron boiler is so strong that in it steam or water gas can be made under pressure, or crowded into a very small space. This crowding, of course, increases its explosive, or expansive, power enormously. Then, if a very small opening is left for the gas to escape, it will spend the force of all the steam in the boiler at that opening instead of on the walls. All the gas wants, you see, is to get out where there is more room.

"Well, you may go out," says the engine builder. "But in going out you must push this piston rod that plugs up the opening like a cork." That is just what it does. The steam pushes the piston rod with the force of all the steam in the boiler, like a great hammer, just as you drive a nail in a board. The piston rod pushing forward and falling back as regularly as the pendulum of a clock, turns the drive wheel. And that is what the engineer means when he says a locomotive is "driven" by steam.

WHAT MAKES AN AUTOMOBILE GO?

Not steam. An automobile couldn't carry a big iron boiler around. One might say that an automobile is driven by canned sunshine, or gasoline. Gasoline is a refined preparation of petroleum that readily turns into an explosive gas. Ages and ages ago the sun helped make petroleum or vegetable oil, as it helped the plants to grow that turned into coal.

Like steam or water-gas, gasoline-gas pushes things to get out, if shut up. It can be let out in such a way as to push machinery. A very little at a time can be made by feeding a few drops to an electric spark. The spark burns the gasoline that is, makes it so hot it expands into gas. Every time the electric spark passes the jet of gasoline a little explosion takes place. As the gas pushes to escape, it pushes the machinery connected with the wheels. So an automobile is driven by continuous small explosions. When it is stopped the gas-making is stopped, too, and there is no waste of power. And

a big tank or boiler is not needed to store the gas. It is made as it is needed, and used up as fast as it is made. When an automobile passes you, you can hear these little explosions that make it go.

WHY WASHINGTON'S EYES FOLLOW US

There is one picture of Washington in which the eyes follow any one who looks at it. It is the portrait painted by an American artist, Gilbert Stuart. The eyes are very large and mild and noble. They seem to look at every boy and tell him to be brave and unselfish and to love his country. That is one reason why we think this the best of all portraits of the father of our country. The face, and especially the eyes, speak so plainly the character of the man. The secret of the eyes is that Washington and the artist were looking straight at each other when the eyes were painted. Eyes that follow the gazer are to be found in "Mona Lisa" and many of the world's greatest paintings. They are to be found in good photographs, too. If the sitter looks straight into the camera, his eyes in the photograph will gaze back, at any angle, into the eyes of any one who looks at it.

WHAT RINGS THE DOOR BELL?

A current of electricity running around a wire, rings the door bell. Then why doesn't it ring all the time? For the same reason that an electric lamp doesn't give light all the time. In both cases we connect and break the current of electricity. The carbon filament in the lamp runs into platinum wires in the neck. When you push in a button or turn a thumb key, the platinum wires are made to touch the copper wire that carries the electric current into the house. The current flows around the carbon filament completing the circuit, and we get a light. So, when you press the button of a door bell a bit of metal under the button presses on the wire that, all the time, carries the electric current to that point. The current instantly leaps along the rest of the wire to the bell, and rings it. In the case of the lamp the current comes from a distant power house on wires, under the streets, between the walls and through the tubing of the electric light fixtures. In the case of the door bell, each house has its own little power plant in the basement, or on a closet shelf. It is an electric battery made with chemicals in a jar. Any careful, clever boy can make such a battery, and explain to a school just how a door bell is made to ring.

WHAT MAKES THE MUSIC IN A PIPE ORGAN?

The pipe organ in the church is a wind instrument. Although it has a keyboard, and is played like a piano or parlor organ by striking the keys, the music is not made in the same way. In a piano the striking of a key brings a hammer down on a wire. The wire vibrates, or trembles. Vibrations produce sound, no matter how they are made—by the beating of the bee's wings, the vapor explosions in a teakettle, the blow of a hammer, or by the passage of air through a crevice or a pipe. When an organist strikes a key, he opens a valve that admits a column of air to one of the pipes. This column of air vibrates in the pipe and makes sound waves. The rate or rapidity with which the air vibrates determines the musical tone. A bird's wings, vibrating slowly, flap; a bee's wings, moving rapidly, hum. In the pipe organ the rapidity of the vibrations in the different pipes depends upon their varying lengths. The air in a pipe eight feet high vibrates twice as fast as the air in a pipe sixteen feet high. So the musical note made by the longer pipe is an octave or eight notes below the one made by the shorter pipe. The organ pipe is of special shape, with a tongue at one end to throw the air into vibration as it enters the column. This tongue is of various materials and shapes to give quality to the tone. But the pitch—the highness or lowness—is decided by the length of the pipe.

WHAT IS A MIRAGE?

Every child who has read stories of the desert, knows that sometimes travellers over the burning sands often think they see, in the distance, one of those green places with water and palm trees that are called oases. They urge their camels forward only to see the vision fade before their eyes. The animals are not deceived. When near a real oasis they smell the water and hurry of their own accord. Such an unreal appearance is called a mirage. But how is it made? And why does it disappear?

It helps in understanding a great many things to know the meaning of their names. Mirage comes from the same old Latin words from which we get both mirror, a looking-glass, and miracle, a wonder and a mystery. So a mirage is a reflection of some unseen but very real object, sent back from an upper layer of air that, in a way that was long a mystery, acts as a looking-glass.

Many things in nature readily become mirrors. A sheet of quiet water reflects an inverted image of all the things along its banks.

Polished metals and woods, painted surfaces, even glossy leaves reflect. The moon is quite dead and cold. It has no light of its own, but shines by the reflected light of the sun. Even a layer of air may become a mirror. This is the way in which it does so over the desert. As a rule, the air nearest the surface of the earth is heaviest, and light rays from the earth pass upwards through gradually lightening air without being stopped. Over hot, sandy deserts the layer of air on the earth becomes more heated and therefore lighter than air that is some distance above. Light rays are stopped by this denser air layer and reflected back. And just as a tree growing on the bank of a pond is reflected upside down in the water, so a reflection, or mirage, is often inverted in the sky. But sometimes it seems to be lifted and merely reversed as your face is in a mirror. Mirages occur over dry plains and also over the far northern oceans. One case is on record in which the entire north coast of France was reflected to a sea-coast town in England, a distance of fifty miles across the English channel. So you may readily believe that the mirage in the desert is the reflection of an oasis that may be a day's journey distant.

DAY AND NIGHT

Why we have both day and night following each other regularly once every twenty-four hours, is supposed to be very hard to understand. It isn't explained to children in school until they get their big geographies in the sixth grade. But it's just as easy as anything.

You see the sun rise and set every day. In the evening the sun goes down the western sky—or seems to go down—until it is out of sight. Then it is dark. In the morning the sun seems to rise in the east, and we have day. The sun has motions of its own, but in relation to our earth it stands still. It is the earth that turns away from the sun in the evening, and toward it in the morning. Push a long hatpin through an orange. Now hold the orange by both ends of the pin, and level with the flame of a lamp. Let's play the lamp is the sun, and the orange the earth. You know, of course, that the earth is a very big, nearly round ball. It is about eight thousand miles through the middle and over twenty-five thousand miles around. The lamp stands still, and keeps right on shining. But its light can shine only on the side of the orange-earth that happens to be turned toward it. It *couldn't* reach around and shine

on the other side, and it couldn't shine *through* the solid earth, now, could it?

Turn the orange-earth over and over, slowly, on the hatpin. That is the way the earth turns. The sun is always shining on one-half of it, but the light half is constantly changing. As the earth always turns eastward toward the sun, the sun *seems* to travel westward. It takes just one day, or twenty-four hours, for the earth to turn over once, and give all parts day and night. So, when it is noon in the United States the little Chinese boys and girls on the dark side of the earth are fast asleep. And when they are hurrying to school very likely we are undressing to go to bed.

WHERE THE DATE CHANGES

This is a little harder to understand. Perhaps you don't know that the date does change—but if it didn't, then when it is Sunday on one side of the earth it would be Monday on the other.

Turn your orange-earth over slowly and watch the light rays strike one side after another. Remember, day is always beginning somewhere. It is always noon somewhere, always night, and it takes twenty-four hours for any one spot on the earth to go through all the changes of morning, noon, evening, midnight.

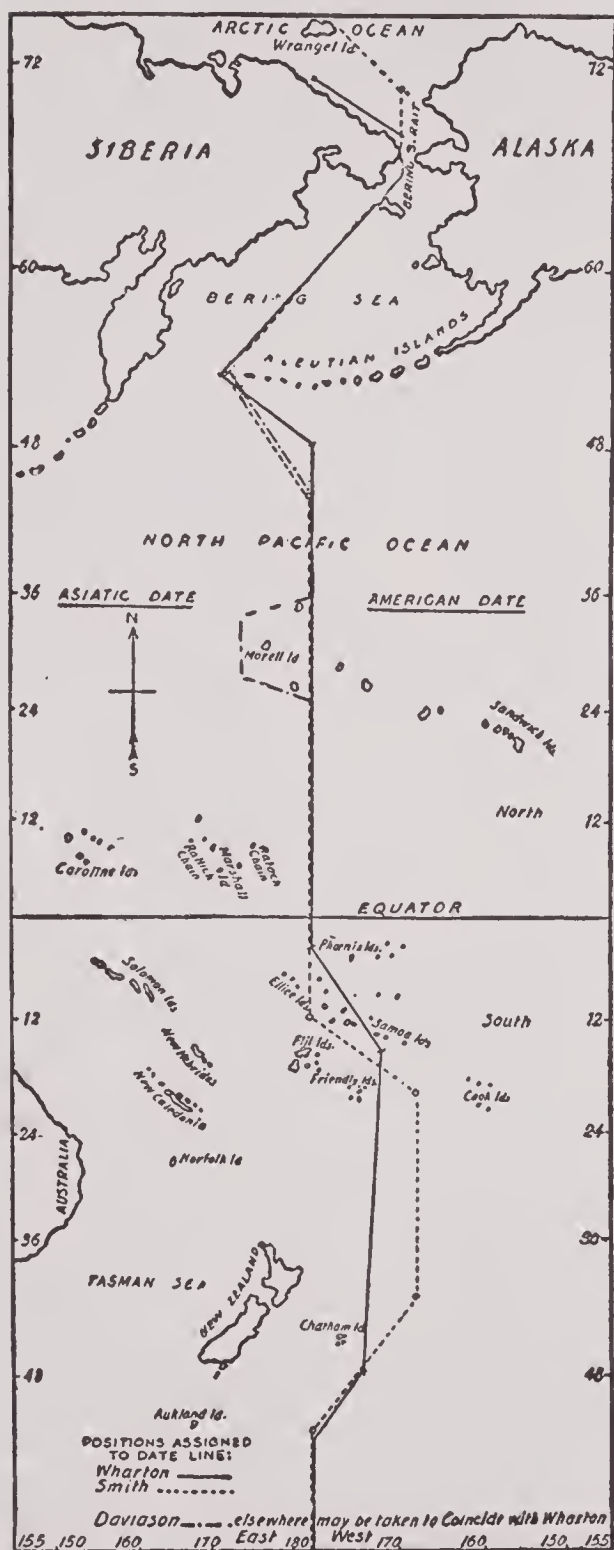
Since this is true, the people of the great trading nations had to agree on a place where a new day should begin for everybody. You see they needed to date letters and telegrams, newspapers and business papers of all sorts. It wouldn't do to have a date-changing line pass through a big city, or even through a country where many people lived. For it would make no end of trouble to say it was Monday on the west side of a busy street, and Tuesday on the east side. A place was chosen to run a date line north and south, away out in the middle of the Pacific Ocean.

Cut a line on the skin of the orange-earth from where the hatpin goes in, at one end, to where it goes out at the other. We'll call that the date line; although, as a matter of fact, the real date-line is not straight up and down, but zigzags about among islands. It goes half way around the earth, up and down the very widest ocean. Now continue the line around, dividing the earth into two halves. On the line exactly opposite the date line stands London, the greatest trading and banking city on earth, with 6,000,000 people living in it. There, time and dates are very important, so the trading nations agreed to keep London time—that is, to date everything

by time in London, and to correct the date on the exactly opposite side of the earth, in mid-ocean.

Pretend you are in London at noon, Monday. You are a giant

with seven-league boots on. You start around the world *westward*, traveling as fast as the earth turns eastward. It is noon all the way around. But, as the journey takes twenty-four hours, you get back to London at noon the next day. Now, go around the earth *eastward*, travelling just as fast as before, against the sun, or in the same direction as the earth. You will meet the sun at noon, when half way around, and in half a day, or twelve hours. You pass the sun and meet it again at noon, in London, twelve hours later. As you had noon-time twice in twenty-four hours, you must count Monday twice. So you lose a day, or have the same day twice in going around the earth eastward, and gain or skip a day in going around westward. When crossing the date line, ships going eastward count the same day twice; westward going ships skip a day to keep their dating correct with London time.



HOW THE SPECTRUM EXPLAINS THE SUN

Do you remember about the wise man—Isaac Newton—who was set to thinking out the law of falling bodies by seeing an apple fall to the ground? He was always curious about common things that everybody saw, but

that no one else thought much about. One day he saw a sunbeam shining through a round hole in a shutter into a dark room. The beam made a golden road to the opposite wall. There it ended in a spot of light. When Newton saw this, he thought:

"I wonder what would happen if I were to catch that sunbeam, and make it pass through this triangular bar of glass?"

Light goes right through a pane of glass, you know. But because of the unequal thickness of the triangle or prism, the beam went through it in a curious way. The ray went to the middle of the prism straight and white. There it was bent at the angle of the prism's sides and spread out like a fan. The round spot on the wall was gone. In its place was a narrow panel, in seven color bands like a thin slice cut across a rainbow. And the colors were arranged in the same order as in a rainbow—red, orange, yellow, green, blue and violet.

Why do you suppose he called this a spectrum? Specter means an image of light, a heavenly vision. He stood in wonder and awe at the unearthly beauty of those color bands of light. And he hoped that he had found a key of light to unlock some of the secrets of the far-away sun and stars. Newton caught starbeams and rays from white hot iron. And he tried the effect of burning the dust of lime, salt, iron and other minerals. He discovered that when salt (sodium) was burned the yellow band of the spectrum came out very bright.

When you boys and girls are hunting a hidden object you know what it is to get "warm." Newton and other scientists who experimented with the spectrum, knew they were "warm," or very close to the secret of yellow when sodium, and nothing else in nature, always made the yellow band blaze brighter. In this way they determined that there is sodium in the sun and the stars, just as there is in our own earth. You see the key of light began to turn in the lock. After long experimenting it was discovered just what element makes each and every color. Everything that was found by the spectrum to exist in our world was found to exist in others.

The spectrum revealed not only the materials of other worlds and furnished a test by which the elements could be detected, but it proved the laws by which light is governed. Across the color bands of the spectrum are many dark lines in which no light or color appears. These are caused by light rays crossing and putting each other out. The only way in which they can do this is by travelling in waves or ripples, just as air and water and sound travel.

It is by spectra-analysis that not only the stars, but the things of which the earth is made today are studied. The telescope, the spectroscope and the camera are united in wonderful ways, to give us true stories and pictures and explanations of the stars. Astronomers can tell us by these, what a star is made of, whether it is coming toward or going from us, how rapidly it is moving and many other things.

Isn't it wonderful that we can catch a light ray from a star millions of miles away in a little glass prism, split it up into a band of seven colors, photograph that band and keep it for a record, and find out from these records that all the suns and stars are made of the same things as the dear home earth we live upon? (See SPECTRUM, SPECTROSCOPY.)

A WORLD OF WONDERS IN A SOAP BUBBLE

A soap bubble really makes one able to believe in worlds where fairies live. Like our world of land and water it is round. It floats in space. Although it is hollow, it is packed and crammed with beautiful mysteries. But mysteries and miracles and magic are usually just the working of natural laws that we do not understand.

In the first place, the soap bubble is only a tiny, hot-air balloon with a skin of soapy water around it. The hot air is forced from your lungs when you blow. Hot air is expanded, so it takes less of it to fill a given space. Therefore it is lighter than cold air. In this little balloon the air inside is so much lighter and hotter than the air outside that it is able to hold up the water-film that forms the skin. Another thing that helps it float is this. If all the water was in one big drop, or even in several smaller drops, it would fall like rain. But the water is stretched and spread out very thin over a great deal of air. So it floats, just as a thin hollow iron ship floats on water, or a kite flies in the air.

Now water alone cannot be stretched in that way. Soap has a much greater power of cohesion, or sticking-togetherness. Soap with glycerine, or a kind of mucilage in it, is still more cohesive than ordinary soap. See how easy it is to make lather, or a great many foam bubbles in soapy water. The soap bubble is round for the same reason that the earth is round. All the little particles of water cling together on all sides with the same force. The air pressure outside is the same on every part, and every part is being pulled toward its own center. It isn't easy to believe that the smooth water-film

YOU CAN LEARN TO BLOW BUBBLES LIKE THESE



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With a pipe, a straw and two rings, you can, with a little practice, blow all the bubbles you see here. You enclose the flower in the bubble by using the funnel as you would a pipe. One bubble is made inside another, and a third inside of that by blowing the first bubble, piercing it with the straw and then blowing the other bubble inside of it.

is made up of tiny separate molecules. But see the rainbow colors it reflects. A diamond cut in faces, catches white light rays and breaks them up in the same way. So the soap bubble would not be able to break up light rays, if it did not have millions and billions of little flat faces.

If you watch a soap bubble closely you will see it sag and gather a drop on the underside. No sooner is it in the air than the earth tries to pull it down. Because of this pull the water on the upper parts slides down the slopes. That makes it heavier below. The heaviness drags it out of its perfect sphere shape. All this time the air inside is growing cooler and is shrinking. The water-film shrinks to fit the air inside, and is pressed in by the outside air. When both are the same weight and temperature, the water skin makes the bubble heavier than the air it floats in, so it falls, just as an apple does. When the bubble touches the ground all the little molecules of water fall together, *downward*, and make one drop.

You cannot believe the glittering little fairy world is all in the soapy splash on the table, can you?

WHY IS THE OCEAN SALT?

There is no salt in fresh rain-water. River water tastes fresh, sea water salty. Yet the oceans are fed by the rivers that flow into them. Then where does the salt in the sea come from?

When rain falls on the ground it soaks into the earth. In the earth are all sorts of minerals—salt, lime, magnesia, potash, sulphur, iron and many others. These are dissolved or melted and carried along by the water. Of all the minerals in the earth salt is most easily dissolved by water. So very often, we have salt springs. Rivers are fed by springs, and all of the minerals are in river water, but not enough so you can taste them. All the time this salt and other minerals are poured into the ocean by the rivers. When the sun takes vapor up into the rain clouds it takes only the water, leaving the minerals behind, just as lime is left in a teakettle. In this way the minerals in the sea, salt and everything else, slowly becomes greater in quantity as the centuries go by. About three and a half per cent of sea water is minerals, today. That is, if you put one hundred quarts of sea water in a tank and boil it until the water is all boiled away, you will have three and a half quarts of dry salt, magnesia, lime, potash and other minerals. The greater part would be salt.

What would you think, then, of water in which there are from fifteen to twenty quarts of salt and other minerals in every hundred quarts of water? The water of our Great Salt Lake and of the Dead Sea is four or five times as salt as the ocean. Like the ocean, they have no outlets in rivers. So they keep all the minerals that come into them. After ages and ages they will lose all their water, dry up and leave great salt beds behind. Do you think that could ever happen to the big oceans?

WHAT IS "HORSE POWER?"

When James Watt invented the stationary steam engine, one of the difficulties he had was to be certain how large an engine was needed to do a given amount of work. He would get an order something like this: "An engine is wanted to pump water from a mine. It must do the work that is now done by twenty-four horses." The thing he had to find out was just how much work one horse can do. He tested many horses until he found that the average force of the working horses then used, was just enough to raise thirty-three thousand pounds one foot high in one minute of time. Allowance also had to be made for friction, or rubbing of the parts of the machinery, and other things. Today horse-power in an engine is not calculated in that way. It refers to the size of the cylinder. A horse power now may mean a lift of sixty thousand pounds one foot high in one minute.

HOW QUICKLY DO THINGS FALL?

That depends. On the weight of it? No, indeed. You remember how Galileo, the great astronomer, dropped a one-pound and a ten pound cannon ball together from the leaning tower of Pisa? They struck the ground the same instant. The speed with which things drop depends upon the height from which they fall. If you fall from the limb of an apple tree sixteen feet from the ground, you strike the ground in just one second. But if you fall from a church steeple three times as high, or forty-eight feet, you strike the ground in two seconds. Every second a falling body gains thirty-two feet on the distance covered in the preceding second. You fall sixteen feet in the first second, forty-eight feet in the second, eighty feet in the third, one hundred and twelve in the fourth and one hundred and forty-four in the fifth, or four hundred feet in less than a twentieth of a minute. This increase in speed, according to the height, is what

makes a long fall "hard." The earth is struck with greater force. The gain in speed would be multiplied many times each second, instead of being added to at the rate of just thirty-two feet, if it were not for the resistance, or pushing back of the air. The air is a cushion. If it wasn't for the air raindrops, and especially hard hailstones, would hit us with the force of bullets.

ARE THE STARS INHABITED?

When you look up at the stars at night don't you wonder if people like ourselves live upon any of them? Some of the stars we know are far away suns, much larger than the sun that lights and warms our earth. A few of them are planets that, like the earth, circle around our own sun. If you were on one of these planets the earth would appear to you as one of the stars in the sky. We cannot really know if people live on the other planets. But we can think of all the reasons why we are able to live on the earth. We have light and heat from the sun, air to breathe, water to drink and to make plants grow. The plants and animals and minerals on the earth are suited to our needs for food and clothing and shelter. If anyone or all of these things differed from what they are we, too, would have to be different, or we could not live here. So if people exactly like ourselves are living on any other world, that world would have to be very much like the earth. Astronomers have not found any other planet that is just like our earth in these things that are so necessary to people made as we are.

The question as to whether there is animal life at all on other worlds, is quite different. On this earth of ours are thousands of varieties of living creatures. They can live in the deepest sea, on the highest mountains, in the coldest and the hottest countries, and on many kinds of food. It would be very strange, among so many worlds, if ours was the only one that would support life. We do know that other worlds are made of the same elements as our own. They have lime and iron and salt and hydrogen, and other things in them that are necessary to life. On our earth, plant and animal life have been developed and fed out of these elements. So it seems only reasonable that where these are present living creatures should be able to exist. On the little red planet Mars, that is nearest us and that we can best study, we have many reasons for thinking that intelligent beings do live. But for many reasons they must be different from us. Mars is smaller than our earth and older. It is

worn down to plains, the sea is smaller, the air lighter. There is less heat and air and water. In order to live there at all, many scientists think the Martians would have to be superior to us. They would have to be better thinkers, and use what they have more intelligently and economically than we do. There are long, straight lines on Mars that some astronomers think are canals, to bring melting snow water from the poles to irrigate dry lands. Such vast engineering works could mean only that the people of Mars must long ago have outgrown wars, and turned to world-wide works of peace. New things are being found out about Mars every year. Some of the children who read this may live to know certainly if this little neighbor of ours is inhabited. If it is, then the Martians, too, may be wondering, and even trying to discover, if our earth is peopled.

WHY LIGHTNING RODS PROTECT HOUSES

In the first place a lightning rod does not protect a house unless the lower end is well buried in the ground. If the lower part of the rod is rusted and broken off at the ground it really attracts the lightning, and then discharges it into the house. Lightning is electricity. Metals attract and conduct, or carry electricity better than anything else does. So if lightning is discharged above a house it is easier for it to go to the metal rod and run down that, than it is to spread over the roof. But there is now less faith in the protective powers of a lightning rod than there once was, and fewer rods are used.

WHY A DOG TURNS AROUND BEFORE LYING DOWN

Dogs are wild animals that have been tamed. They have been tamed for so many hundreds of years that they are very different from any and all of their wild brothers of today—wolves, foxes, bears, jackals, and the wild dogs of the Esquimo tribes and of the Bushmen of Australia. But dogs have certain habits to which they cling, that came down from the wild dogs of many hundreds of years ago. One of these habits is the burying of bones. Another is this turning around and around before lying down. Wild dogs had to bury the bones they could not make use of at the time, to keep other dogs from carrying them away. And they had to make their beds in jungle grass or drifted leaves. This turning trampled a space flat for a comfortable bed, and left a wall of standing grass around it that hid the bed from prowlers. So today, you will see petted house dogs of high and long breed, burying bones stealthily, and turning

around before lying down on the hearth rug. In the dearest dog friend we have, is something just a little untamed, and that seems to be what we need to connect our lives with all the beauty and mystery of natural things.

HOW DOES A SPONGE HOLD WATER?

Do you want to be told? It's more fun to find things out for yourself. Get the smallest glass tube that is sold in drug stores. Put one end of it into a glass full of water and see what happens. The water rises in the tube a little higher than it stands in the glass. No one knows just why it does this. It is thought that the wall of a tube has an attraction for the tiny molecules of water, and pulls them up a little way. The finer the tube the higher the water is drawn up into it.

Now a hair is a very small, hollow tube. The sponge is made up of hair-like hollows that pull up or, as we say, soak up water. The Latin word for hair is capillary. So this force is called capillary attraction. Sugar, salt, starch, chalk, sponges and the hairs of animals and fibers of plants have capillary attraction. You can prove this by dipping threads, strings, pieces of cloth, the edge of a lump of sugar or salt in a liquid, and watching the water climb. It is by capillary attraction that water is pulled from the roots to the farthest leaves of tall trees. The water is not only *pulled* up, it is *held* up. If the hair tubes of a sponge or a towel are too full, some of the water falls or drips away, but most of it is held until it is evaporated into the air.

WHY SOME PEOPLE ARE LEFT-HANDED

Are you left-handed? If you are, very likely it worries mama and papa and all your teachers. It shouldn't worry them. And really it is a great waste of useful time to try to make you right handed. The trouble—if it is a trouble—is in the brain. For some reason that no one understands, the nerves of our bodies cross over, so the right side of the brain controls the left side of the body, and the left brain the right side. Usually the left brain is a little the larger, so it takes command and makes the right side of the body leader. When, about six times out of a hundred, the right brain is larger, it makes the left side leader. It is supposed that the left brain in most people gets more blood because the heart is on the left side. This makes ninety four or five people out of every hundred right-

handed. Remember this: Left-handed people are just as bright, and just as "handy," or clever, with the hands, as right-handed people. Of course it looks odd to see a person eat and write with the left hand. But "looks" don't count for much when work is to be done. A left-handed pitcher wins many a game of base-ball.

WHY A POP-GUN POPS

A pop-gun pops from an air explosion. The front end of the gun is made air-tight with a cork or plug. At the other end is the plunger, that fits the round bore just tight enough so it can be forced down to the plug. The bore is, of course, full of air. This air has no chance to get out. So when you push the plunger, the air is squeezed into a smaller space before it. It really becomes compressed air. Air doesn't like being squeezed any more than you do. To get out, it pushes and pushes until the plug gives way. "Pop!" The air instantly expands and sets sound waves in motion. As the act is quick and sharp and short, the sound made by it is also. "Pop!" just describes it. Shut your lips to say "pop." Fill your mouth with air from the lungs. Then let go and speak the word suddenly. In that way you make the same kind of an air explosion as the pop-gun. The power of compressed air is so great that it is used to make drills bore holes in the rocky walls of mines, and to hammer rivets in the iron work of bridges and sky-scrapers. Your pop gun is really a very scientific toy

HOW CAN A CAT SEE IN THE DARK?

In the first place a cat cannot see in *pitch* dark. It can only see by less light than you can. You can see in very bright light, and also in dim light. If you come out of a rather dark room where you saw well enough not to bump into things, into strong sunshine, you have to shade your eyes a moment until the pupils become smaller and admit less light. So, in going from brightness to dimness, you can see better after the pupils of the eyes have had time to expand. The eye is a wonderful automatic—or self-regulating—little window. It can shut out light if there is too much, or open up to admit all the possible rays if the light is too dim. The pupils of the cat's eyes are able to close like narrow slits in a shutter, to keep out the noon-glare of the sun; and to expand to a big round window that catches all the rays in semi-darkness. You see cats—lions, tigers, leopards and all the beautiful wild cousins of your playful kitten—are night

prowlers. They sleep and rest in the daytime, and hunt their prey at night. The house cat hunts mice at night. So a cat needs eyes that are veiled from strong light by day, and that can expand to admit all the few rays of light that are abroad at night.

LIVE SILVER—WHAT IS IT?

When mama sends you for something in a hurry, she says: "Run, quick!" The real old meaning of quick is to be alive. When you run quick you have to be very much alive. So when men found a silvery white metal that ran about in the liveliest kind of way, they called it quick, or live silver. They called it mercury, too. That means much the same thing. Mercury was the young messenger god of the Greek people. He had wings on his heels, and when he was sent on an errand, he fairly flew.

Quicksilver isn't really alive. It just happens to be melted, or in a liquid state. Gold, silver, iron, copper, lead and all metals can be melted, if they are made hot enough. The difference is that quicksilver is a sort of polar bear, or Esquimo metal. Temperatures at which other metals are solid, just melts quicksilver. If heated to a temperature that melts gold, away Mercury goes in vapor or gas, like water. Cold shrinks quicksilver, heat expands it. Indeed, it is the most sensitive thing we know that is not alive. That is why it shrinks and swells, running up and down the little tube in the thermometer, and tells us the slightest change in the temperature of the weather.

Quicksilver behaves as it does because it is a liquid. You cannot pick it up for the same reason that you cannot pick up water. But it does not wet paper. The reason it doesn't soak into things is because it is denser than any solid thing we know. It is so much heavier, for the space it fills, that gold, silver and iron float on it as wood floats on water. Besides, it likes its own company best. No matter how much of it you pour out on a table it will not spread. Every particle clings together in one ball. If you split that ball up, each lot will roll up into a smaller ball, or bead. And if these beads get near enough to each other they promptly run together again. The particles of quicksilver have a stronger attraction for each other than anything else has for them. They have a strong attraction also for other metals. They seem to swallow gold and silver and other metal dust, in the most curious ways. So men have learned to send little Mercury ball messenger boys into all the cracks and crannies

of powdered gold and silver ores, to swallow up and bring out every grain of the precious metals. How they get the gold and silver away from the Mercury when it swallows them, is another story. (See MERCURY, METALLURGY, GOLD.)

THUMB PRINT AUTOGRAPHS

Look at the ball of your right thumb very closely. It would be better to look at it through a reading glass or microscope. It is covered with very fine lines that sweep in curves around a center. Sometimes these lines form a circle in the middle; sometimes an oval, sometimes a letter U, or a spiral like a letter S. Press the ball of your thumb on an ink pad such as is used for stamping. Then press it onto a sheet of white paper. Try until you get a clear print of the lines with no smears. That is your thumb autograph. No other thumb in the world, not even your own left thumb, will make a print just like it. Take the thumb prints of all the members of your family and of your friends, and see if you can find any two alike. Thumbs are like faces. No two are alike. This is curious, but you can't see how it is of any use. It is. When a thief or other criminal is caught, a photograph is taken of his face and this is kept by the police. But it has been found that a man cannot always be known by his face. If a smooth-faced man grows a beard it changes his appearance. Age changes faces, too. But a thumb ball has lines that do not change. So now, besides the photograph, the police take thumb prints of the bad men they catch.

FAIRY PRINCE ECHO

Nearly all ancient peoples had pretty, poetic stories about the echo. Some, very likely, thought merry little fairies really lived in rocky caves and valleys, to shout and laugh back at them. No one really knew what an echo was until wise men discovered that sound travels in waves, just as water and light and electricity travel. (See ACOUSTICS, WAVE-MOTION and "SOUND WAVES AND THE TELEPHONE.") If a wave of water is stopped by a break-water or a cliff, it is thrown back into the sea. So if a sound is stopped by a wall it is thrown back to our ears. A big empty building, especially if windows and doors are closed so the sound waves cannot escape, is a fine place for echoes. Best of all is a rock-walled glen in hilly country. The sound very seldom comes back just as it was made. When a wave of water is stopped it is broken up and thrown back

in spray. So a sound wave when stopped, is broken into an airy, shattered echo. It really seems as if some mocking sprite calls back from a fairy grotto in the rocks.

WHY THE EARTH IS ROUND

Well, why is a raindrop round? Why is lead shot round? Maybe you think shot is moulded like bullets. It isn't. The lead is melted. Then it is showered like rain from a tall shot tower. As it falls the liquid drops turn over and over. A force called gravity pulls all the parts of the little mass toward the center of it. And, as each one whirls the air presses on all sides with equal force. As the drops fall they cool and harden into tiny globes. Once the earth was in a soft, molten state and it, too, whirled through space and around the sun. So it was made round, and it cooled and hardened in that shape. The same forces keep it round. The sun, the moon and the stars are all globes.

If the earth was all water, and if it constantly changed the direction of its whirling as a baseball does when pitched, it should be as round and smooth as a ball. But it is of water, soft earth and hard rocks, so the friction of the air is uneven. And it turns always along one line that runs through the north and south poles as straight as a string through a bead. So along that line the earth is flattened. Midway between the poles where the whirling is most rapid, the earth bulges.

THUNDER AND LIGHTNING

That is the order in which we speak of them. But really we should say lightning and thunder. They are both made the same instant, by two electric currents in storm clouds coming violently together. This produces both light and heat. Heat expands the air. The expansion starts a great wave or billow of air to rolling, and makes the crashing sound we call thunder. But as light waves travel faster than sound, we see the flash before we hear the crash. If the two come very close together we know the sound did not have to travel far, and the storm causing both is very near. As a storm center moves away from us, the time between the flash and the roll lengthens. In that way you can tell when a storm will soon be over.

HOW AND WHY OF ETIQUETTE

RULES THAT GOVERN THE DRESS AND MANNERS OF PEOPLE OF GOOD BREEDING AND THE CUSTOMS IT IS SO EMBARRASSING NOT TO KNOW.

"Teaching manners and morals is plainly one of the most important parts of education."—DR. CHARLES W. ELIOT, PRESIDENT EMERITUS OF HARVARD.

THE PRINCIPLES OF GOOD MANNERS.

"Good morning."

That's the way to begin each day in society—with a pleasant greeting. And you are "in society" as soon as you are outside your bedroom door. Did you ever think of that? You will never find better company, anywhere in the world, than in your own family, so don't save your best manners for strangers. They won't wear out by using them. On the contrary, good manners are a habit. If they are not begun at home and constantly practiced there, you may forget to put them on when strangers are about. As you go through life you will want to make friends of the very nicest people you meet. But if you are boorish in your manners, well-bred strangers will not care to know you.

"But there are so many rules it is hard to remember all of them," you say.

There aren't so many, really. It's like Arithmetic—a few rules and a great many examples. One of them has been put into a rhyme that you should commit to memory:

"Politeness is to do and say
The kindest thing in the kindest way."

Think how many acts that one rule should inspire. Your very first thought should be to care for other people's feelings. Next, you should be self-forgetful, self-possessed and self-respecting. Third, be natural. A selfish person may know all the customs of good society, but he never can be perfectly well-bred. A self-conscious person is

shy, and that makes him awkward and ill at ease. One who lacks self-control is nervous and unconsciously falls into habits which annoy other people. Besides, he is easily surprised and quick tempered, and so is betrayed into hasty speech and action. A person who is not sure of his own worth is usually snobbish. He curries favor of people whom he thinks above him, and is rude to his supposed inferiors. Finally, simplicity is the key-note of good breeding. Affected, pretentious manners are in bad taste because they are insincere.

You see, manners are very close to morals. The only sure foundation for them is a fine character. Having that one cannot go very far wrong in the important things of behavior. That is why you may find good manners on a poor and lonely farm, and very bad manners in a rich and socially prominent family. There are people of great wealth in every capital of the world who knock in vain at the doors of good society, and poor men who are welcomed in royal palaces. When Lincoln went to the White House as President, there were many customs of society that he had never heard of, but no one made a mistake about his being a gentleman. He was kind and helpful, he was true, he had personal dignity and moral courage. Then, he was observant, so that he readily picked up the many social requirements of his high position. Social customs are much the same everywhere. There are small local differences that are quickly discovered by keeping one's eyes open. Every observance has some good reason behind it. Oftener than you think you will find yourself saying: "Why, of course, that is what a well-bred person would do."

*Good manners, as we call them, are
neither more nor less than good behavior,
consisting of courtesy and kindness.*

—SMILES.

Good Manners in the Home.

One of the Happiest Investments You Can Make—Points About Personal Cleanliness, Neatness and Dress—Bright Smiles and Clean Teeth—What They Do for Grandmothers in Europe—Your Manners at Home and in Other People's Homes—About Candy Parties and the "Fidgets"—The Rights of Children and Their Elders.

When you come out of your room in the morning, you should be perfectly clean and fully dressed. After the bath, special attention should be given the face, hands, finger-nails, hair and teeth. A girl's shoes should be laced, her dress buttoned, her hair ribbons prettily tied, her belt and neck dressing adjusted so they cannot get out of order. A boy's shoes should be polished, there should be no high-water mark under his cuffs, and he should have on his collar, tie and coat. In very hot weather the coat may be left off, but his trousers should be snugly belted, not held up by suspenders. It is due your own self respect to be clean and neat. And to appear soiled and untidy is to show a lack of respect for other people. This is a social law that applies to every occasion, from a President's reception to breakfast with your own family.

HOW TO BE PROPERLY DRESSED.

Your clothes of course should suit the occasion. For every day home, school and business wear, the best materials of their kind may be used, but the garments should be simple in style and serviceable. You should not be out of style, nor too far in style. Extremes are not in good taste. It is better to be a little under-dressed than over-dressed. You will not "look like everybody else," if you study the art of dress. Find what colors and styles suit you—there is always a wide choice—and bring out your own individuality. But don't make the mistake of buying cheap and tawdry things. And it is the worst possible taste for a child to be dressed elaborately or in more expensive materials

than his parents. In practically every other country than America, the oldest ladies wear the handsomest gowns.

The writer has never forgotten a lesson in correct dress that she saw in a country house near Dublin, Ireland, at an afternoon tea. In an old family of position and wealth, there were four generations of ladies. The great grandmother of eighty, was in black satin, with a cap and collar of point-lace, pinned on with diamonds. Her daughter-in-law, the mistress of the house, wore a foulard silk gown, with Irish lace, a pearl pin and several handsome rings. The twenty-five year old daughter of this lady, came in from a walk, in a tailor-made serge and a picture hat of beaver. Her tie pin and belt buckle were of dull silver and jade. A little six year old great-granddaughter came down from the nursery in white mull with not an inch of embroidery or lace about it. She was as clean and sweet as a daisy, but her only ornament was her golden hair, tied with a fresh blue ribbon and rippling to her waist.

**What Do
You See in
This Home?**

American girls, especially when they get into high-school, or begin to earn their own clothes in business, are apt to dress showily. Elaborate hair dressing, false hair, powder, high heels, thin hosiery and blouses, low neck-dressing, unnaturally small waists, jewelry, plumes and perfumes, make just the opposite impression intended. They attract attention. This no lady ever tries to do; and it is the kind of attention that would shock an innocent girl if she understood it. Well-bred people think it such a pity that a sweet young girl should look so bold; and employers who are desirable do not care to have such conspicuous girls in their offices. The working girl, the school girl and the society girl on the street should wear simple tailor-made suits, serviceable shoes and quiet hats. For neatness and cleanliness, no style is so good as the washable shirt-waist. A girl's "dress up" clothes should be as pretty as possible, but still simple and not of heavy, expensive materials.

**What Some
Girls Do in
High School**

THE HAPPY EVENING AT HOME.

The evening at home is the pleasantest part of the day, a little island of peace and affection in the voyage of life. Never take troubles home with you. Everyone has his own troubles and it is unkind to add

to them, weak and selfish of you to expect anyone to help you bear yours. In the evening hours everybody under the home roof should be happy and free from care—the members of the family, those who are employed to work for you, and the guests who are visiting you.

As it is unjust and unkind to make extra work for mother or the maid, boys and girls should never forget to wipe their feet on coming in, hang up their wraps and put their school books in some regular place. If they want to go into the kitchen to make candy, in the evening, they should not leave a dirty stove, saucepan and sink for the cook to clean. Good girls will not stay in a family where the children are saucy and troublesome, and that makes it harder for mother.

Americans are the most nervous, restless people in the world. The very hardest thing for an American child to do is to learn to sit still; but if you could see a French lady sitting perfectly still, listening attentively and smiling, you would think what the French call “repose” a beautiful thing. Children should learn not to fidget, rock, drum with their fingers, tap the foot on the floor, cross the legs and swing one, jump up and down, squirm in a seat, bite the nails or lips or twist the face. All these are nervous habits. There are children in every schoolroom whose lips and fingers and feet are never still, and whose foreheads, by scowling and lifting of the eyebrows, have become as wrinkled as a washboard. And haven’t you seen a serene, self-controlled lady whose face is unlined at sixty? As your face does no work it should stay young at least as long as your body. The only kind of wrinkles that are excusable before old age, are the crow’s feet around the eyes, that are made by laughing.

A SURE TEST OF GOOD MANNERS.

You can always tell if a family uses its good manners all the time, by the way an old person is treated. In that matter of respect and tenderness for the old we could not do better than imitate the Chinese. In Great Britain, as you have seen from the example of the Irish home, the oldest members of a family are treated with the greatest honor. In Sweden the grandmother has a special sofa and

footstool near the fire. It is a mark of honor to be asked to sit by her. In America the Jewish people keep the old patriarchal idea toward the aged. A boy should bring the most comfortable chair in the room forward for his grandmother. A girl should fetch a shawl for chilly shoulders, see that the reading-lamp is properly placed and thread a needle for dim eyes. If grandfather is deaf, sit near him and keep him in touch with the conversation. Don't shout to him. Shouting often confuses the deaf, and besides it calls other people's attention to his affliction. He is much more apt to understand you if you raise your voice very little and take care to speak distinctly.

**More Good
Examples
from Abroad**

A boy should rise with his father, when ladies enter the room, and see that they are comfortably seated. Everyone should be cheerful, good-tempered, ready to talk, or to listen to music or to reading aloud and to join in parlor games. You should neither do all the talking, and thus make a bore of yourself, nor sit glum as if you were nursing a grievance. The old idea that children should be seen but not heard, is no longer held. Children's interests are just as important as grown people's—but they are not more so. They should not be allowed to interrupt or correct anyone else. A child's mistakes should be corrected by near relatives because he is a learner, but he should not be ridiculed or snubbed or teased, or be allowed to chatter about nothing.

**The
Rights of
Children**

Evil communications corrupt good manners.

—NEW TESTAMENT.

Good Times at the Table

*A child should always say what's true,
And speak when he is spoken to,
And behave mannerly at table;
At least as far as he is able.*

—ROBERT LOUIS STEVENSON.

You Can Have the Best Times Where There is the Most Good Breeding—How to Sit—What to Do and What Not to Do with Your Napkin—Knife and Fork Etiquette—How Bread Should Be Eaten—The Soup and the Spoon—About Second Helpings and Good Appetites—Table Talk—The Neighbor's Children at Meal Time.

The first social affair of the day is breakfast. Well-bred people are strict about table manners. All your life you will sit at table with other people three times a day. Think how many chances that is in a year to make yourself agreeable. If your table manners are offensive, your family may overlook the matter, or endure your boorishness in silence, but well-bred acquaintances will never ask you to eat a meal with them. And you should know that an invitation to dinner is the very highest social honor one person can pay another.

Sit upright at the table. Do not slide down on your spine, nor sprawl forward on your elbows. Unfold a small breakfast or lunch napkin to its full width, a large dinner napkin to half its width, and lay it across your lap. Don't tuck it in your neckband or button-hole. A baby needs a bib, but a child should learn early to eat without spilling food. Keep your hands in your lap until you are served. Don't fidget with your knife and fork, drum with your fingers, kick a chair or table leg, or tap your foot on the floor. These are nervous habits that annoy other people. Learn by watching older people how to hold your knife and fork properly. Don't make a noise in eating and drinking, take enormous bites or chew with your mouth open. To eat fast looks greedy

**Six Things to
Do and Sixteen
Not to Do at
Table**

"AND BE MANNERLY AT TABLE"



THREE RIGHT WAYS OF EATING



THREE WRONG WAYS OF EATING



ONE RIGHT THING AND TWO WRONG THINGS TO DO AT TABLE

and is bad for the digestion. Don't bite into a slice of bread and butter. Break the bread into suitable pieces for eating and butter each piece separately. Don't bend over your plate and give the effect of shoveling your food into your mouth, and don't reach for things. Ask the waitress or the person nearest the dish to pass it, saying: "If you please."

WHEN IN DOUBT, USE THE FORK.

Never put a knife blade into your mouth. A witty man has said that a gentleman may take liberties with the English language, but not with his knife. A knife is used only for cutting food. A very small, sharp knife is for paring and dividing fruit, a small, blunt knife for spreading butter on bread. So limited is the use of a knife in eating that, at dinners of many courses, you may have but one knife at your plate, but a dozen forks. All beverages are taken directly from a glass or cup, or sipped with a spoon. Soup, watery vegetables and fruit sauce, berries, grape fruit, halved oranges, cantaloupes, ices and soft puddings are eaten with a spoon. Bread, small dry sandwiches, crackers and cheese, small cakes, many solid fruits, nuts, olives, pickles, celery, radishes, corn on the ear and firm stalks of asparagus are properly taken up in the fingers. Practically everything else is eaten with a fork—even peas, soft layer cake, club and mayonnaise sandwiches. Cream cheese should be put on a cracker with a butter spreader. A good rule is: when in doubt use a fork if possible. On an elaborately set table, a broad-tined fork is provided for eating ice cream.

**What Knives
and Forks and
Spoons are For**

**When You
May Use
Your Fingers**

HOW SOUP SHOULD BE EATEN.

In eating soup, dip the edge of the spoon that is farthest from you, to fill it, and take the soup from the side. Don't tip the plate to get the last spoonful. The butter spreader when not in use, is laid on the bread and butter plate, a teaspoon in the saucer. Don't litter the table-cloth about your plate. Put bones, potato skins and other refuse on your bread and butter plate or at the side of your large plate. If asked, tell which part of the chicken you prefer, or if you like your beef rare or well done. You need not wait to begin to eat until everyone is served, but don't begin so soon as to leave everyone else behind. A meal isn't a race.

If you wish a second helping of anything, ask for it. A delicate appetite isn't fashionable, and a hostess is flattered when people like the food she has provided. Of course, then, it is very bad manners to criticize the food or cooking. You need not eat anything you do not care for, or that you know is not good for you, but let it be served to you and say nothing about it. Children especially should be taught not to say that they do not like something that is on the table, to be surprised at an unfamiliar dish, or to ask for something that is not served. It is a mark of social experience to have a taste for a variety of foods and styles of cooking. People who do not like this and cannot eat that will find themselves left out of dinner parties and luncheons. And if they go abroad where every country has its national cookery, they are likely to go hungry in the midst of plenty, and miss one of the pleasures of travel.

About
Second
Helpings

POLITENESS TO THE WAITER AND OTHERS.

Don't thank a waiter for serving you, any more than you would thank a clerk in a store. It is his business to serve. But if you ask some extra service it is gracious to say: "Will you please."

Don't read a newspaper nor private letters at the table, thus obliging others to sit in silence, for fear of troubling you. A family letter from a near relative may be read aloud, for it is full of news and cheer and makes a topic for conversation.

Never notice an accident. In Japan if anyone at table overturns a dish or breaks a cup, no one sees it. They begin to talk about the chrysanthemum show, or someone tells a funny story. A laugh is a breeze that blows clouds away.

A Lesson
from
Japan

THE RIGHT KIND OF TABLE TALK.

Table talk is a fine art. Because unpleasant thoughts interfere with the enjoyment and digestion of food, certain topics must not be mentioned at table. Among these subjects are death, disease, sanitation, special diets, calamities, crimes, family quarrels or faults, business or school or neighborhood troubles, or anything about which people differ widely and are likely to get excited and argue. Table-talk is light, bright and crisp, never very serious.

When you have finished eating, drop your napkin unfolded, beside your plate since at a dinner party a napkin is not supposed to be used again; and lay your knife and fork on your plate, side by side, not crossed. Don't pile up your dishes, with the idea that you are helping the waitress. She has her own method of collecting dishes and you may confuse her. Don't use a tooth pick at table, nor anywhere except in the toilet, unless it is absolutely necessary. In that case hold a napkin before your mouth. Of course you will not go about with a tooth pick in your mouth. If you are obliged to leave the table before the others do, ask the hostess to excuse you. At home that's mother, remember. She will say "certainly," graciously. Then rise and bow to her, and bow again to include all the others at the table.

**When You
Have Finished
Eating**

SHOULD WE "INVITE OURSELVES?"

It is not good manners for children to "run in" to meals with friends and neighbors. Grown people do not invite themselves in other people's houses, so why should children? And boys and girls should not invite company to meals in their own homes without their mother's permission.

**Boys and Girls
and "the
Neighbors"**

They are putting her to trouble and disarranging the work of the maid. One mother made it a rule that when her sixteen-year-old daughter brought a guest to dinner, she must return from school in time to set the table properly, arrange the flowers and make an extra salad or dessert. That was excellent social training. Men and boys cannot do the extra work that is necessary for the proper entertainment of guests, so they should ask in the morning or call up over the telephone to make sure that company is convenient for mother to have.

*The small courtesies sweeten life; the
greater, ennoble it.*

—BOVEE.

On the Street

"Keep Sweet and Keep Moving."

—ROBERT J. BURDETTE.

Rules About Bowing and Lifting the Hat—When One Should Bow to Strangers—When One Should Offer One's Arm to a Lady—Getting On and Off a Street Car—"Dos" and "Don'ts" Governing Conduct Inside the Car.

After breakfast a family scatters to school, business offices, to work, etc., and on various errands. Everyone is on the street at some hour of the day, so there is a special code of manners for the street, public conveyances and public places. The principle of street manners may be summed up in a sentence: Look pleasant, keep to the right to avoid collision, be self-possessed, go along briskly, mind your own affairs and do nothing to attract attention.

ETIQUETTE OF THE BOW AND THE LIFTED HAT.

Recognize acquaintances with a bow. If near enough a pleasant greeting may be exchanged. A lady bows first to a gentleman. A gentleman bows, touches his hat or gives a military salute to his men friends, but he lifts his hat to women. He bows to his mother, wife or sister, in meeting or parting from them, as ceremoniously as if they were strangers. Two ladies who meet step to the inner edge of the walk, near the building, if they wish to talk so as not to be in other people's way. If a gentleman wishes to talk with a lady, it is better to turn and walk in her direction. And when he is walking

When a Gentleman Bows	with a lady, a gentleman lifts his hat to anyone she recognizes whether known to him or not. The lady, however, does not recognize his friends. A man lifts his hat in passing strange women in hotel parlors, halls, on stairways and in public elevators. It is not necessary to keep his hat off during a trip in an elevator. He may catch cold if he does and politeness never obliges anyone to do anything dangerous to himself, unless to protect the weak and helpless. Remember a bow is a social civility, the smallest coin of society. It does not mean a calling acquaintance
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and may be given to anyone. A bow or a lifted hat should never be refused to anyone who thinks he recognizes you. He may be mistaken, and if he is he would feel humiliated by the snub.

When a gentleman is with a lady, he takes the outside of the walk because that is the most exposed place. He does not offer his arm unless the lady is old or lame, or it is after night and she is in danger of being separated from him or jostled in a crowd. Women are not the delicate, helpless creatures they were once thought to be. A child, an old person of either sex or a blind or crippled man should be helped, when they need to be, in crossing streets or entering and leaving cars. A question from a stranger should be answered civilly, and you may ask directions of anyone politely. If you can do so, it is best to appeal to policemen, car-conductors, or go into a corner drug store.

About
Offering
One's Arm

WHEN OTHER PEOPLE ARE ILL BRED.

Never resent the behavior of an ill-bred stranger. If he wants more than half the road, give it to him. Lincoln once said: "If a man won't turn out for me I turn out for him. This keeps the peace and expedites travel." Remember, no one can insult you. He can simply show his own bad manners. But no man or boy should stand by and see a bully abuse an animal, a child or other defenseless person. Make him stop if you are big enough. If not, call for help or a policeman.

PROPER BEHAVIOR IN PUBLIC CONVEYANCES.

A gentleman who enters a street car with a lady, helps her up the steps and follows her. In leaving a car he gets off first and helps her down. He gives her the inside seat next the window, and facing forward, and pays her fare. But if she is not the guest of another person, a lady should pay her own fare. Two ladies should not squabble over who pays the fare. It simply makes them conspicuous. Have your fare ready for the conductor and ask for a transfer or for information quietly but distinctly. The car makes a good deal of noise. This is a good rule, too, in thanking anyone who offers you his seat. You should not be willing to accept a favor from anyone without thanking him, audibly and pleasantly.

It used to be thought that a man or boy should give up his seat to any woman or girl who was standing. Now, good manners do not absolutely require him to offer his seat to anyone who is as well able

About	to stand as he is, but I always think better of a man
Giving Up	or boy who does it, don't you? A strong man or
One's Seat	woman, boy or girl, should give up a seat to an old or

ill person or cripple, of either sex, to a woman who is carrying a child, or to a laundress with a big basket of clothes.

No well-bred person will crowd, shove, carry an umbrella or cane at a dangerous angle, wear hat pins that threaten other people's eyes, tread on people's feet or put his own so far out in the aisle that other people stumble over them, chew gum, eat peanuts and scatter the shells, talk or laugh aloud in any public place, or occupy two seats in a car when others are standing. For this last offense there is an ugly name and a person who commits it quite deserves it. You should not raise or lower a shade without asking those nearest if they will be inconvenienced. A gentleman who sees any lady in difficulties with a window should offer his help. If the ventilation of a car is bad, and it usually is, speak to the conductor about it. Don't put your feet on the seat opposite. Shoes have street dust on them, and you shouldn't want to use the clothes of the next person to sit down, as a door mat.

*Of manners gentle, of affections mild;
In wit a man, simplicity a child.*

—POPE.

For a Girl Traveling Alone

The Question of Dress and the Wearing of Jewelry—What Courtesies May be Accepted from Fellow Travelers—In the Pullman—At the Hotel—Ordering One's Dinner—When Reading at Table is Allowable—The Waiter and His Duties.

It is our boast that, in America, an attractive young lady may go from New York to San Francisco and not be in any way molested. On the other hand, countless girls, through ignorance of what is and what is not proper to do, get into serious trouble in making even a short journey alone. A girl traveling alone should dress quietly, in a tailor-made suit, or in a simple dark gown of wool, silk or linen, and wear a small hat and a long dust coat. She should wear no valuable jewelry, nor carry more money, in cash, than she needs for the journey. She should have her tickets, checks, keys and small change in a handbag where she can get at them readily.

**What to
Wear When
Traveling**

A coat or other article in a seat is notice that it is occupied and the holder of it absent temporarily. A lady should take a seat that is entirely unoccupied, if possible, and she may remove her hat, veil, coat and gloves if she wishes to do so. Then she should sit quietly and enjoy the landscape from the window or read a magazine. She may accept a slight service from a fellow-traveler, such as lowering the window, but if a man annoys her by trying to make her acquaintance she should remove to another seat, or speak to the conductor who will protect her. A man or an elderly woman may talk to anyone, but a young woman may talk only to another girl, to children or a mother with children or to a very old lady. No one should tell any travelling acquaintance anything about herself, or her destination, exchange cards, accept invitations, or any favor beyond the loan of a magazine or similar courtesy.

**About
Traveling
Acquaintances**

IN THE PULLMAN.

In a Pullman car there is a special conductor and a colored porter, and in the long distance express trains a colored lady's maid, whose

business is to look after the safety and comfort of passengers. An electric bell in the wall of each berth will be answered at any moment, day or night. When your berth is made up you have to sit in it, behind the curtains to undress, but you should take off only your outer garments and put on bed slippers and a dark silk or wool kimono over the underwear. In those you can go to the dressing-room, with toilet articles in a hand bag. Learn to make your toilet as quickly as possible so as not to keep others waiting.

If a mistake has been made and friends fail to meet the train, there is always a telephone in the station to call people up. In small

If Friends	places the station agent is there to advise travelers.
Fail to	In large cities, a policeman is always on duty, and
Meet You	there is usually a matron who will take a girl without

escort to her friends or to a safe lodging. Any good hotel will, on call, send a cab at any hour, and with a responsible driver, to bring a guest. A woman who arrives in a strange city after nightfall, and who has not enough money to go to a good hotel, who does not know where to go and has no safe escort, should remain in the station waiting-room until morning.

MANNERS IN HOTELS AND RESTAURANTS.

A lady who is stopping at a hotel alone need only to be quiet in dress and manners, self-possessed and have money to pay her bills. She should write her name and home address in the register, give any large sum of money and her small valuables to the clerk to be put into

Things to Do	the hotel safe, lock her trunk on leaving her room;
and Things	lock the door and leave the room-key at the desk on
Not to Do	going out. She should not run up and down the

stairs, hum tunes in the halls, stare out of windows, stroll in the lobby, use the elevator twenty times a day, play on the piano in the parlor or sing. A bell-boy will take her shoes down to be polished, or call a cab; a waiter will get a newspaper; a chambermaid will hook a gown at the back. For extra personal services a small tip should be given. If a hotel servant is inattentive or impertinent, do not reprove him, but report the matter at the desk.

In the dining room ask the head-waiter for a quiet table at the side or in a corner. He will remember your face and give you the same table next time. Decide quickly what you want to eat. Break-

fast may be ordered at once, but it will be brought on in courses thus —fruit; a cereal; bacon and eggs; toast and coffee; griddle cakes and syrup. The dinner menu has so many things on it, some of the names in French, that it is confusing to the inexperienced. If you do not know what a dish is, ask the waiter without embarrassment. You are expected to order only one kind of soup, fish, entree, roast, salad and dessert. You may order your coffee in a large cup to drink during the meal, or a small cup of black coffee with crackers and cheese, at the end, as you prefer. You may omit any course, or order as simple or as elaborate a dinner as you like.

**In the
Dining
Room**

In an American style hotel the charge by the day includes meals. In hotels conducted on the European plan the charge is made for the room. Meals may be taken in the restaurant connected with the hotel, or in any other place you prefer. There, of course, you order from the card, at a stated price for each dish. Larger portions are served than under the American plan, and a two course lunch or a three course dinner is usually sufficient.

Don't fidget or be embarrassed at table in any public place. No one is paying any attention to you. You may read a newspaper or make out a shopping list or a program of engagements for the day while waiting to be served. If a stranger passes the salt, thank him, but do not get into a conversation. A group of friends dining together should talk quietly, but not about personal affairs. Ask the waiter for any service you may require within the sphere of his usual duties. If ladies are alone he will help them on and off with their wraps. It is proper to give the waiter a bill when he brings the check, and let him pay the cashier. Then give him a small tip if you wish to do so.

**Etiquette of
the Table
at Hotels**

*Manners must adorn knowledge, and
smooth its way through the world.*

—EARL OF CHESTERFIELD.

Politeness in Business Life

The Relation of Good Manners to "Getting On" in the World—How Misbehavior in School Handicaps a Boy in Business Life—Why Some Doors are Closed to Some People—Good Manners in Public Places.

From the street men go into business offices and factories, children into school rooms. School is, in part, a child's business life and, in part, his social life. Good manners there are the same as in the workaday world, and places of public use. A pupil should be on time with well-prepared lessons, and clean and neat in appearance. He should

How Rude	do the work that is expected of him, and be atten-
Boys are	tive, respectful and obliging to the teacher, and he
Handicapped	should not disturb the work of his classmates. A

boy who has been idle, mischievous and noisy in school, and rude to his teachers, will have to unlearn such manners before he can hold a place in a business office. He should not tell tales, in school or out. No employer wants a whiner, and a tattler is sure to tell business secrets.

The money value of good manners should be taught to growing boys and girls. We all know men of brains, honesty and industry, who have succeeded in business, who are personally disagreeable. But

Money Value	they would have had a larger and easier success, more
of Good	friends and a pleasanter life if they had been well-bred.
Manners	In the business, as in the social world, many doors

are open to good-breeding that the boorish man cannot batter down. Of two boys or girls who apply for a place to work, the one whose appearance and manner make the best impression is likely to be given the chance.

Boys who start out with good manners will find business life much pleasanter and, with equal industry, will rise faster than boys who are rude and thoughtless in their behavior.

Begin by being courteous to your fellows at play. It isn't the boy who pushes or crowds that gets on best with his fellows, and this is just as true when you get to working in an office or "on the road."

A good salesman usually has, among other things, a stock of good humor. People like him. "Cheeriness, the cordial greeting, the warm hand clasp, the friendly smile, the straight, direct level eyes," says a prominent business man, "these are the best introductions for a salesman. Business should be done in an atmosphere of sunshine, not of gloom.

"Courtesy in business means success in business. Courtesy gets the audience, courtesy listens, and tact sells the goods."

Merchants who buy, as well as salesmen who sell, have learned that it not only makes you feel better to be courteous to your fellow man, but that it pays. A good business man will not refuse to see and listen to a salesman, because he has learned that, if he did, he would lose a great many valuable opportunities to buy to advantage. And the business of thousands of merchants has been built up largely because they have been courteous to their customers. People like to trade with them. What is called "good will" is more valuable to a merchant than anything he keeps in his store; and "good will" means just that—the "good will" customers have toward a business man or a business house.

Meaning of
"Good Will"
in Business.

GOOD MANNERS IN PUBLIC PLACES.

The kind of behavior that is required in a well-conducted school-room is expected in church, theater, concert and lecture-hall, libraries and art galleries. At any place of public worship or entertainment, it is ill-bred to arrive late, to be fussy in settling into a seat, to turn and stare about, to whisper, giggle, yawn or flutter the leaves of a book. Such behavior is unkind to the minister or entertainer, and interferes with the pleasure of an audience. A lady should take off her hat whenever she sees that other ladies have done so. In church it is bad manners to look at a watch or to leave before the services are over. One may leave a theater or concert, quietly, between the acts or the numbers on a program, but should express no disapproval of the play or music. In an art gallery visitors are usually required to check canes and umbrellas at the door. This is because people often point at pictures and sculptures with these, and are liable to punch a hole through a canvas or knock a small bust from a pedestal. In libraries no talking or unnecessary noise is allowed. Questions should be asked of attendants in an undertone.

Listening and Talking

Skill in Both are Necessary for the Beautiful Art of Conversation—
What Makes a Pleasant Voice—Do You Say “Yes” and “No” as You
Should?—The Sarcastic Person, the Prosy Person and Other Kinds of
Persons You Don’t Want to Be.

Very often young people complain that they do not know what to talk about in society. Talk about pleasant things. The German poet, Heine, has said: “God has given us speech in order that we may say pleasant things to our friends.” Then a pleasant voice, low, clear, with an upward inflection, makes the most ordinary words sound pleasantly in the ear. Don’t let your voice or your mouth sag at the corners. Look straight at the person who is talking to you. A half open mouth, a vacant stare, a wandering eye and restlessness, are all ill-bred. Then, in answering, speak distinctly. Don’t whine or mumble or shout.

USE THE SIMPLER WORD AND AVOID SLANG.

There are so many little niceties of speech. Did you ever notice that the best books, and the stories that you love to read again are written in the simplest language? So it should be in speaking. Always use the shorter and simpler word. “Home,” for instance, is better than “residence.” It means more. You should say: “I am going to bed,” not: “I think I shall retire to my room for the night.”

And with so many good words in the dictionary, it seems a pity that anyone should use the slang and careless talk of the street. Don’t say that a thing is “fierce” or call an entertainment a “bum show,” boys.

And girls, such expressions as “my goodness” and “did you ever” mean nothing and sound silly. Don’t say “awfully sweet,” “perfectly elegant” and “just terrible” to describe very ordinary things. Overdressing your ideas is in as bad taste as overdressing your person.

Girls,
This is
for You

HOW TO SAY “YES” AND “NO.”

Don’t say “uh-huh” in answering a question, or “what!” if you failed to understand. Say: “Yes, mama,” “No, Mrs. Adams.” “Yes

sir" and "no ma'am" have gone somewhat out of fashion, but they are always good manners, and old people think no other forms so respectful. But nowadays we use peoples' names in addressing them. So if you wish to have something repeated, say: "I beg your pardon, Mr. Stuart." Use "please" and "thank you" and "pardon" freely. They are drops of oil in the wheels of society. And if you are used to saying these things you will not find it hard to apologize for a mistake or an accident. Why should it be difficult to admit that you were in the wrong? To err is human, and everyone loves to forgive. Just say: "I beg your pardon. That was stupid of me"; or: "I am so sorry, mama; I never meant to hurt you."

**It's Easy to
Apologize
If You Know
How**

Don't talk about yourself or your wonderful doings. Don't tell long, prosy stories, or give information or advice, unless they are asked for, and then be sure they are wanted. Don't interrupt people or help anyone tell a joke. Don't get excited over an argument, or be sarcastic. Sarcasm comes from a Greek word that means to tear flesh like a dog, and it still means to be cutting, wounding in speech. Wit at other people's expense is a two-edged sword. It hurts the victim and kills friendship.

**One Person
You Should
Not Talk
About**

REMEMBER WHAT KING ARTHUR SAID.

And don't gossip. You know what King Arthur said to his knights? "Speak no evil, no, nor listen to it." A malicious story may not be true; it is certainly unkind, and it should not interest you. Rebuke scandal by silence and by changing the subject. Your mind is a crystal bowl, not a sewage catch basin. Sir Galahad had the strength of ten "because his heart was pure."

Talk of things and ideas, not persons, except interesting public persons like presidents, actors, authors, artists and musicians whose talents give wide pleasure. Talk about the last book you read, how pretty Mary looks in her new hat, the Junior Civic League and how it is improving the town. Be brief, be merry and bright. Draw out other people and listen. Good listeners are scarce and popular. Try to remember all the amusing things you see and hear. A laugh is sparkling, and brightens everyone up.

**The Kind of
Things to
Talk About**

Don't try to appear profound, nor ride a hobby. People who are worth while in society are apt to be as serious as you are, but they need, all the more, to be relaxed and amused. Think before you speak: "Is this kind or wise or witty?" Flattery is unkind because it is insincere, but a well-turned compliment is always agreeable. It is unwise to make long explanations or apologies or to repeat the clever things you said yesterday.

DRAWING OTHER PEOPLE OUT.

Remember not to monopolize the conversation or sit glum and irresponsible. It is said that Lord Macaulay, while a brilliant talker, had equally brilliant "flashes of silence" in which he drew other people out to talk their best. Don't be witty at some one's expense, unless it is in defense of some principle, and then be good-natured about it. Don't remark that a story some one has just told was invented in the Ark. The remark itself is antique. Don't tell an inappropriate story that will fall flat, nor miss the point. A low voice is an excellent thing in a man or woman, and a well-modulated, musical voice in conversation is a thing that is too little valued. Learn to express your thoughts in clear, simple English without violence or exaggeration.

Don't talk "shop." Shop to men is office affairs, money, markets, stocks and bonds, deals, "cases" for the doctor and lawyer, theology for the minister. Shop to women, is children, servants, clothes, bargains, dishonest tradesmen. Don't slight anyone, sneer or indulge in a superior smile at awkwardness. Don't carry disagreeable news, nor repeat to people the unkind things that are said about them. Don't warn people of their faults or tell them that they are looking bad. Never touch anyone, unnecessarily, unless very intimate. Familiarity is offensive. Ladies may be warm friends for years, yet never use each other's Christian names nor kiss each other.

WHAT YOU CAN DO WITH YOUR ACCOMPLISHMENTS.

Cultivate some gift that will give pleasure to others and be generous with it. If asked to sing, play, tell stories, read aloud or join in a parlor game, do so at once, cordially, or give some real reason for refusing. Don't wait to be teased, or you may be disappointed. Your refusal is ungracious and few people will urge you.

While you should not be drawn into heated arguments on politics or religion, or any subject on which people think deeply or differ widely, good breeding does not oblige you to sacrifice your principles. A person without opinions is colorless and uninteresting. You should always defend your country and its customs, but without anger. The witty wife of an American diplomat in London thus answered a young lord who remarked, rather superciliously, that there could not be any real society in the United States because America has no leisure class.

About
Politics and
Religion

"Oh, yes, we have," she said with perfect good humor, "we call them tramps." She was applauded, and no one appreciated the retort more than the victim of it. Another time, on being asked by a countess if an American woman then in London was a lady, or if she was employed on a newspaper: "I understand that she is both," was the quiet answer, and the great lady apologized for applying the British standard of class to an American, who needed to be only well educated and well-bred to be a lady.

There is a courtesy of the heart; it is allied to love. From it springs the purest courtesy in the outward behavior.

—GOETHE.

Social Life for Children

Some Things a Child Should Not Be Allowed to Do—Entertaining Little Visitors—When Visitors are Impolite—The Child's Correspondence—Conduct of a Child's Party—Form of the Invitation—Place of the Older Person.

A child should not be banished from the family living room when visitors are present. He should learn to be at ease with strangers. Very early he should be able to greet a guest politely, to answer questions properly and not to ask too many. A "smart" child should not be "shown off" nor allowed to hang on a visitor, handle her belongings and chatter. As he will have little interest for a grown-up caller, he should amuse himself quietly. If a guest is staying in the house no child should be allowed to go to her room uninvited, nor be curious or meddlesome. He should watch, however, for chances to do little services. If the mother is obliged to take a child along when making calls, he should be told not to handle books, ornaments or hangings in other people's houses. But a child's chief social education should come through his own family, in the school room and by association with other children.

Very early a child should have his own little visitors and learn how to entertain them properly. Many grown-up people are awkward about making introductions. A little five-year-old girl should find it perfectly natural to lead a playmate to her mother and say: "Mama, this is my friend, Marion Howard." The visitor should be greeted cordially, even ceremoniously: "I am very glad to know you, Marion. Helen talks about you so much." "You see, mama, we both just love dolls," says the beaming little hostess. Both chil-

Polite	dren are impressed by the courteous treatment and
Welcomes to	put on their best behavior. They learn to introduce
Little Friends	people naturally, that the young person should be

presented to the older one, the gentleman to the lady. Then they should be told to pronounce names distinctly, for it is embarrassing not to catch the new names, and if they can mention some mutual interest, like dolls or base ball, that starts a conversation without awkward pause.

A CHILD'S ENTERTAINMENT OF VISITORS.

A child should be held strictly to account for treating little visitors politely and hospitably. A small tea set and simple refreshments are a great help. Occasionally a child should be allowed to invite a guest or two to the family luncheon, and for his guests a special dish and decorations should be provided. Given high standards of conduct and opportunity to judge others, children learn early to make wise choice of their friends. One day a little friend of the writer's helped a playmate put on her wraps, opened the door for her politely and smiled as she said good-bye. No one knew anything was the matter so perfect was her self-control, until she came to her mother with red cheeks and snapping eyes. "I'm never going to invite Elizabeth Brown to see me again. She threw my things around and broke a teacup, and she never apologized."

The Choice of Little Friends

"What did you say to her, dear?"

"I didn't say anything. I couldn't because she was my visitor. But I just boiled inside."

She was entirely right. The little visitor was ill-bred, and abused hospitality. A lady shows no irritation, no matter how boorish a visitor may be, but she is careful to cut from her list of acquaintances anyone who is so lacking in breeding as to make her "boil inside."

CHILDREN'S CORRESPONDENCE.

As soon as a small person can write at all, he should have note paper and be encouraged to write to relatives, to thank people for gifts and to answer his own invitations in proper form. And, of course, a letter to a child should not be opened before he sees it. A letter is a very personal possession and a beautiful mystery. The child's right in it should be respected and his pleasure in it be unspoiled. If his letters are opened, it will be difficult for him to understand that he should never open or read another person's letter. Do not be afraid that he will be secretive about his correspondence. A child always runs to mother with a letter if certain of her interest, for he wants to share his pleasure. And he will consult with her anxiously about how letters should be answered.

THAT GLORIOUS EVENT—THE CHILDREN'S PARTY.

The greatest social event of a child's life is a party. Many mothers do not believe in children's parties, thinking them too exciting to the nerves and upsetting to the digestion. But a lawn-party, with simple games and refreshments, may be made a pure delight, do no harm and be a means of social education. The little hostess should do everything possible herself; select the guests, with mother's advice, write the invitations if old enough to do so, have a voice in the refreshments, decorations and games, and stand with mother to receive her guests properly.

The wording of the note should be the child's natural expression, for you know simplicity is good manners. She may write:

Dear William,

Please come to my birthday party. I will be eight years old on the seventeenth of May. The party is from three to six.

Your little friend,

Marjorie Murray.

For any gala occasion a child should be daintily dressed, but in washable materials. They are not cheap when laundry bills are taken into account. Clothes, once put on, should be forgotten, or the wearer will become self-conscious. A child should wear nothing that he must remember not to spoil. A black velvet suit on a little boy or an embroidered marquisette over pink silk, on a little girl, may come to disaster, and the consequences of its ruin spoil what ought to be a happy memory.

DON'T HURT ANYONE'S FEELINGS.

In a small town all the children of a suitable age should be invited; in a larger place the classmates in school and the children of family friends and neighbors. The more there are the merrier, and there should be no distinction of class. As we grow older, we have duties and interests that compel us to limit our circle of friends to those who are congenial to us. But little people do not need to be so exclusive, and snobbiness in a child is something unnatural and odious. Besides the hurt that is felt by a child who knows of a party and is not invited, is deep and lasting.

Refreshments should be served near some meal hour, and it is an attention that is not appreciated by friends to stuff their children with

rich indigestibles. Cocoa and chicken sandwiches, plain ice-cream and a simple cake are sufficient. Souvenirs of a party are treasured by children, even the decorated paper napkins, a place card and a flower.

An older person should oversee the games and quell disturbers, for alas, all the little guests will not be well-behaved, and see that shy children are not neglected. The old, old games, such as puss-in-the-corner, drop-the-handkerchief, blind-man's buff, forfeits, charades and pin-the-tail-on-the-donkey, are always popular.

Kissing games are no longer permitted, as promiscuous kissing by young or old is in bad taste, and epi-

Supervision

By an Older

Person

demics are started that way. There may be a fish-pond, a grab-bag or a May-pole. If papa's purse is long enough, a story-lady may be engaged for an hour, a sleight-of-hand-man, a man to show lantern slides, or a lady who plays the banjo and sings funny darkey songs. Such a party is nothing less than a fairy story come true to a child. It is vividly remembered, and the laws of hospitality involved are impressed upon the mind.

Courtesy is a science of the highest importance. It is like grace and beauty in the body, which charm at first sight, and lead on to further intimacy and friendship.

—MONTAIGNE.

GOOD FORM

We often hear that a person or an entertainment was in "good form," and are not clear as to just what that means. Manners have their basis in morals, but "form" is social experience and good taste. For instance, it is not impolite to use printed instead of engraved visiting cards, nor for a man to be married in evening dress in the daytime, but both are bad form. To be in good form is to do what custom has established as suitable to the occasion. Not to do these things is to appear awkward and sometimes ridiculous. Here is a case in point: The charm of a young girl is her freshness and modesty. For her to appear at her coming out party in a low cut gown and diamond necklace is an offense against good taste. She is a "bud" not a full-blown rose.

Young Men and Women in Society

When Debuts are Usually Made—Dress of the Debutante—Her Mother's Dress—How Long Callers Should Stay—The Table and Its Color Scheme—The Refreshments and Who Should be Invited—Reasons for the Chaperon—The Young Man's Social Duties—What He May Do and What He May Not Do.

A young girl may be introduced to society at any age that her formal education is finished—at eighteen, on leaving high or boarding school, or when she has completed the course at college. In her first season in society she is called a debutante, a French word that means "one making a first appearance in society."

INTRODUCING A DEBUTANTE.

The introduction may be made at an afternoon tea or reception, or at an evening reception and dance. It is usually made in November, at the beginning of the winter gaieties. The affair is like any of the sort with the exception that the young lady's name appears below her mother's on the invitations, and she stands beside her mother to help receive the guests and to be introduced to those of her mother's acquaintances who are unknown to her. The proper form of this and other invitations will be found in the article on "The Etiquette of Invitations."

It is a proper and graceful attention for anyone who is invited to send flowers to the debutante. One of the charms of a coming-out party is the quantities of flowers in the rooms and the number of fresh young faces, as it is a pretty custom to ask other girl friends to help receive and to pour tea. The young lady who is introduced should dress in white of some soft material, from silk mull to daintily embroidered marquisette over silk, and made with a round Dutch neck and elbow sleeves, and of dancing length. She may carry a bouquet of white flowers but wears no jewels, unless there is a single string of pearls in the family. She wears white hose and slippers. The girls who "pour" should be similarly dressed in delicate colors. The debutante's mother wears a handsome reception gown, high-necked and trained, in the daytime, and an evening gown, low cut or with bust and arms veiled, in the evening. She may wear jewels, but good taste forbids a hostess from outshining her guests in her own home. Ladies use face creams and powder, but not rouge.

**Dress of the
Debutante and
Her Girl
Friends**

As at any other tea or reception, a guest arrives at any time within the hours specified. Gentlemen leave their hats and overcoats in the hall, but ladies keep on their hats and gloves, unless remaining for the dance, and no one stays more than half an hour. The latest comers chat with the receiving party until others arrive, when they pass on to mingle with other guests and to go to the refreshment table. While eating they slip off their gloves.

HOW THE TABLE SHOULD BE SET.

The table is beautifully set on the bare, polished oak or mahogany partly covered with lace and embroidered centerpiece and doilies. The flowers and candle shades should carry out some color scheme of white or pink or yellow, with green foliage, and the finest of china, silver and cut glass should be used. As refreshments are taken by guests standing, they should be such as may be taken on one plate and with the help of a fork and spoon. For a tea a green leaf of the best quality should be used, and served both in cups with sugar and cream, English fashion, and in tall engraved glasses, with lemon and sugar, Russian style. Besides the tea are tiny sandwiches in two or three varieties, olives, radishes, celery hearts, small cakes, salted almonds, mint paste, candied ginger

**The
Refreshments
and How They
Are Served**

and chocolate bonbons. At a reception, the refreshments are more varied. Instead of tea there may be bouillon in cups, hot or cold, creamed oysters or chicken croquettes or salad, small rolls, ices, frosted cake, fruit punch, besides the olives, nuts and bonbons. A string band or pianist may play softly behind a screen of palms. A pleasant ending of an afternoon affair is to have the young women who help receive remain to dinner, and to invite an equal number of desirable young men. At an evening reception both men and women wear evening dress, the ladies in gowns of dancing length.

With such an entertainment a hostess pays all her social debts to those invited, and the list should include her entire visiting list. She

Who	owes no calls, except where she has been entertained
Should Be	at dinner. Her daughter is "out," helps her mother
Invited	receive at home, and should be included in all invitations. In very high society a debutante's name appears on her mother's visiting card, and she uses no personal card for a year. It is not good form for her to appear at any social affair without her mother or some other older lady as a chaperon.

REASONS FOR THE CHAPERON.

In all European countries the chaperon is universal, but custom differs widely in America, and properly so. Until recent years our young girls were allowed complete liberty. We boasted that they were perfectly capable of protecting themselves and that American men, if not so polished as foreigners, were more truly chivalrous. In small places where boys and girls grow up together, and everyone is known to each other, the custom continues, with some restrictions as to buggy riding and late hours. But in the cities, which grow larger and society more mixed, the strict chaperonage of young girls has become a necessity, as in London and Paris. The too lively young person has been put into the background, and society has gained in interest and elegance. Today, we scarcely recognize the picture of unchaperoned "Daisy Miller" and her foolish mother, in Henry James' story; and those who fail to realize the peril of the unprotected, unadvised girl in the "smart" society of today should read of the disaster that befell "Lily Bart" in Mrs. Wharton's "House of Mirth."

Really, if she only knew it, a girl can have ever so much more fun and true liberty, under the wing of her mother or other older

woman. She can go anywhere, see anything. She can travel, stay in resort hotels and join in all the gaieties, go to the charity ball, to the theatre and opera, and take supper with a merry party at midnight, in a public restaurant, and ride home in a taxi-cab. She can take tea in a bachelor artist's studio. She is taken to the proper places, meets only the right people. At a dance, her chaperon may seek the acquaintances of desirable young men and introduce them to her young charge, when the unchaperoned girl is left to be a wall-flower. If she lacks beauty she is not neglected, and if she happens to be pretty and to have many admirers, such guardianship protects her from ill-natured gossip. No one dares snub her and scandal cannot touch her. A good chaperon is worth more, socially, to a young girl than great beauty or fortune.

**Greater
Liberty Under
Protection**

WHERE A CHAPERON IS NOT REQUIRED.

A professional woman, a working girl, or a student is in business, and a society girl on a shopping trip or errand of charity is, also. They may properly do what they must do, and are protected by their work and respected. But a girl should be careful not to meet young men "by accident," as the stories have it, in a gallery or store or library or on a lonely walk, and remain to talk with him for hours unless she wishes to be talked about. Much more liberty is allowed the young woman of twenty-five or more, than to the young girl of eighteen or twenty; and a single woman of mature age, especially if she be at the head of a father's or brother's house, has the dignity and privileges of a married woman. She receives as a hostess and may properly chaperon young sisters and nieces. In traveling abroad, however, a single lady or a widow will find her position much more agreeable if she is in the company of another lady or a married couple.

**These
Exceptions
Prove the Rule**

MANNERS FOR MEN IN SOCIETY.

A young man's manner towards the young women of his acquaintance are just as definitely understood. No gentleman calls upon any lady unless he has been asked to do so, or he brings a letter of introduction from a mutual friend, is taken to the house by an intimate friend or has previously been asked to dinner. He cannot pay "atten-

tions without intentions" to a young girl—that is, flirt with her. If
When and interested in her especially, he must ask for her father
How to and mother also, in calling at the house, or he may be
Make Calls so unlucky as to never find her "at home." If
he wishes to take her to the theater or opera, he must include her
mother in the invitation, or he is likely to be refused. He has the
privilege of asking a common acquaintance to introduce him to any
lady, but the friend should be careful to ask the lady's permission.

A young man should not make long or late calls on ladies. A
mother may properly ask any young man to accompany herself and
her daughter to a public place. In that case, she provides the tickets
and the carriage. The young man so honored may repay the compli-
ment by sending flowers and taking a box of bonbons to his hostess.
He should study graceful ways to pay his social debts, and not be
willing to accept dinner, dance and other invitations without making
proper return. He can entertain by giving theater parties and sup-
pers; take ladies out in his automobile; pay his calls promptly and
often, and make gifts of flowers, bonbons and popular books, to the
mothers as well as the daughters. He should not propose to take
any lady to a place where he would not wish his own mother or sister
to be seen. If a girl to whom he is not engaged should be so foolish
as to give him her photograph, or to write him a gushing letter, he
will not show these to other men, nor allow them to speak of his
women friends in public places. A man who through vanity permits
a slur on a woman's name is a "cad" who is rebuked and dropped by
other men, and women shrink from him in fear and loathing.

*There is no outward sign of true courtesy
that does not rest on a deep moral founda-
tion.*

—GOETHE.

Engagements and Weddings

Difference Between American and European Ideas—Engagement Rings—Allowable Gifts by the Fiance—Payment for Wedding Expenses—When Invitations Should be Acknowledged—Dress and Duties of Those Who Take Part in the Ceremony—About the Rice and Slippers—Good Form in the Style and Use of Wedding Announcements.

In one thing America has refused to import its manners from Europe. We do not “arrange” marriages. A girl is protected from flirtations, undesirable and fortune-hunting young men, but marriage for love is encouraged. When a young man of good character, education, agreeable manners and prospects in business, decides that he wishes to marry a certain girl, the opportunity to tell her so is always given him by her guardians. He proposes and is accepted before he “asks papa,” although, of course, no well bred young man or woman would become engaged without the approval of the parents of both families.

The engagement should be announced at once to immediate relations on both sides. If living in the same city, the young man’s family calls on the family of the young lady, and invites them to dinner. There should be no delay or lack of cordiality in welcoming the girl of a son’s choice. If living in another place, the young man’s mother should write an affectionate letter, and ask the future daughter-in-law to visit her and her daughters. Later the girl sends personal notes to her own intimate girl friends, announcing the news, or she gives a luncheon to them and displays her engagement ring for the first time. For the ring a diamond solitaire is first choice, but it may be any jewel except a pearl, which suggests tears, or an opal, which is considered unlucky. A sapphire is very beautiful. Some weeks before the wedding a general announcement is made in the society columns of the local papers, in both cities, if the man and the girl live in different places.

**Announcing
the
Engagement**

In this country a good deal of liberty is allowed the engaged couple. A girl may receive her fiance alone, but in a room which is

open to the family. She may drive with him in the daytime, in an open carriage or automobile, and appear at afternoon receptions, matinees, concerts or at art exhibits without a chaperon. She may lunch with him in a fashionable tea room, give him her photograph, correspond with him and visit his mother and sisters under their chaperonage. But she should not travel under his escort, nor stop

Relations of in the same hotel with him, unless her mother is with
Fiance and her, nor dine alone with him after dark, nor attend
Fiancee evening entertainments with him alone, nor sit talking alone with him in her own home until a late hour. This may seem strict, but engagements do not always end in marriage. For the same reason a young man may not give his fiancee anything of value beside the ring. He can shower her with flowers, books and confectionery, but should not give her so much as a pair of gloves to wear. If the engagement should be broken the ring should be returned.

The groom's wedding gift, usually a necklace, brooch or other jewelry, and as costly as his purse can buy, he presents on the wedding morning, and the bride wears it to the altar. He is allowed to send the bridal bouquet to her, pay for the wedding ring and license, and
Gifts give the minister his fee. He may also give a souvenir
by the nir to the best man and ushers—a scarf pin—and
Groom a locket or bangle to the bridesmaids. The bride's family pays for everything else—the trousseau and household linen, which is marked with the bride's maiden initials; the invitation and announcement cards, the decorations at home and church, the music, carriages and wedding breakfast or reception refreshments. This rule is as fixed as the Constitution of the United States. The bride may be poor, the bridegroom rich—still she has only the kind of wedding her family can pay for.

WEDDING GIFTS AND INVITATIONS.

Gifts may be sent to the prospective bride by relatives and intimate friends at any time after the engagement is made public. Acquaintances may properly wait until the invitations are out. Presents that are bought are sent from the store, with the giver's card inclosed. It is as well not to have silver marked, as the bride may be oversupplied with some articles and wish to exchange them. Before

the wedding day the bride should write a personal note of thanks for every gift. Nothing excuses her from this duty. Invitations to a wedding should be sent out two or more weeks before the ceremony. All the acquaintances of the family should be invited to a church wedding or none. Otherwise it is better to have a quiet home wedding and invite no one but the immediate families, and then send out announcement cards to all acquaintances immediately afterwards. Invitations, announcements and the small cards to the reception, or the "At Home" card of the newly married pair should all be handsomely engraved, on the finest quality of paper, and inclosed in an inner and outer envelope. Models are given in the forms of invitations at the end of this article.

**Who
Should Be
Invited**

An invitation to a church or home wedding and reception requires no answer. One accepts by attending, or regrets the inability to do so by sending the personal card to arrive the morning of the ceremony. If invited to a wedding breakfast, however, you should accept or decline at once, as a seat is reserved for you at the table.

"GOOD FORM" AT WEDDINGS.

If a couple are married at home, and are leaving at once on a wedding journey, both should wear traveling suits, the bride in her hat, and removing her street gloves for the ring. For a full dress affair, at home or in church, in the daytime or evening, a bride is robed in a trained gown of pure white, high-necked and long-sleeved, or with long gloves to meet her elbow sleeves. Her shoes, hose, gloves, fan, veil and wreath should be white, and she may carry a shower bouquet of white flowers. For a dress wedding in the daytime, the bridegroom wears a frock coat of black broadcloth, light grey trousers, white vest and tie, pearl colored gloves and a silk hat. But after six in the evening, he should wear full evening dress of black broadcloth, low cut white waistcoat, white tie and gloves and pearl studs.

**Dress of the
Bride and
Groom**

At a church wedding the front pews are reserved for the families the groom's relatives at the right, the bride's at the left. Attending the bridal couple is a best man and maid of honor, from four to eight ushers and an equal number of bridesmaids. In addi-

tion, there may be two to four pages and flower girls, under ten years of age. The best man and ushers are dressed like the bridegroom but wear wedding favors in their button-holes, while he wears one flower from the bride's bouquet. The maid of honor may wear white and a picture hat of flowers or plumes, but the bridesmaids are usually dressed all alike in some delicate color, with hats, and made up in some picturesque style. Pages may be in black velvet cavalier costumes, the flower girls in Kate Greenaway gowns, bonnets and baskets. Women guests should wear reception dresses; the men frock coats in the daytime, full evening dress after night.

The best man goes to church with the groom and waits at the altar with him for the bride. The maid of honor is escorted to the altar by the brother of the bride or groom, or by her own fiance, who steps aside. When the wedding march begins, the ushers lead the bridal procession up the white-satin ribboned aisle two and two, separate at the altar, half going to the right, half to the left. The bridesmaids follow, and separate to right and left. Then comes the bride on her father's arm. He gives her to the groom and then falls back. The bridal pair clasp hands and kneel before the clergyman. During the ceremony the maid of honor holds the bride's bouquet and left glove, and the best man holds the groom's hat, gives the ring to the minister and hands him his fee in a small envelope. He and the maid of honor sign the register as witnesses in the vestry, and stand nearest the bridal couple at the reception that follows. The groom takes the father's place in the bridal carriage for the drive home.

THE WEDDING BREAKFAST OR RECEPTION.

In America a reception and buffet lunch at the bride's home is usually given after a church wedding. When the house is small, however, the wedding breakfast to the near relatives and bridal attendants is often given. This is a pretty English custom. It is really a luncheon at which ladies keep on their hats. A suitable menu is chilled grape fruit or melon or unstemmed strawberries, bouillon (hot or cold), raw oysters, hot birds, chicken or lobster salad, ices, jellies, some kind of fruit punch to drink the healths, the usual nuts, olives and confectionery, and, of course, the bride's cake. For a wedding in sum-

mer at a country place, the breakfast may be served to many guests at small tables on the lawn. Small pieces of wedding cake are already put up in dainty ribbon-tied boxes, and each guest takes one on leaving. On the departure of the bride and groom only relatives and very intimate friends kiss her, and the shower of rice and old slippers is best omitted. It is not in the best taste, and horses have been frightened into running away by being pelted. Also, it is offensive to a lady to find her bridal baggage labelled so as to advertise the affair to strangers. Now and then, a wedding guest with a too hilarious sense of humor has found himself cut off the list of acquaintances of a newly married couple on their return home.

SENDING OUT THE WEDDING ANNOUNCEMENTS.

In sending out wedding invitations there is no way provided for telling friends when and where the newly married pair are to be found. If no large wedding is given, the announcement cards are sent out after the ceremony, the new address and the time when the couple may be found "at home" is put in the lower left-hand corner, or their personal joint card, with this information on it, is inclosed. Or, if the residence is undecided, they may wait until they have returned and established themselves in the new home and then send cards to all friends. Socially, the bride and groom are new people, and owe neither calls nor invitations to anybody. All acquaintances owe calls to them, and dinners, receptions, luncheons and teas are showered on them for three months. They return calls, but do not have to entertain until the next season. The bride should be especially attentive to her husband's relatives and friends.

*Self-reverence, self-knowledge, self-control,
These three alone lead life to sovereign
power.*

—ALFRED TENNYSON.

Calls, Introductions and Visits

Proper Type for the Visiting Card—What to Put On It—Presenting the Card—Length of the Call—How Things Have Changed Since “Daisy Miller’s” Time—Dress—Customs Governing the Making of Introductions—As to Shaking Hands—Relations of Hostess and Guest.

A very high authority, both in this country and abroad, says that the fashion in visiting cards has changed very little in a century or more. In ordering her new cards, the bride should select the best quality of white, unglazed bristol board, in a size about two and one-eighth inches by two and seven-eighths. She should have them printed from a plate carefully engraved in small script, Old English or German text, whatever the fancy of the moment may be, but she can always use script if she prefers it. A married lady uses her husband’s full name, thus: “Mrs. John Sidney Payne”. And in the lower right-hand corner of her card she has her street address and her receiving day. Her husband’s card, which she leaves with her own, in paying calls, (for American men are so busy that many of their social duties are attended to by proxy) is a much smaller oblong, in the same style, but nothing on it besides his full name. Middle initials are no longer used.

A minister, a doctor, a judge, or a military or naval officer, may use his title on his card, but his wife may not. “Mrs. Dr.” is absurd. Even the wife of our President is simply Mrs. Woodrow Wilson or Mrs. Grover Cleveland. A widow may continue to use her husband’s Christian name, as does Mrs. Potter Palmer, or she may return to her maiden name, Mrs. Bertha Honore Palmer, or she may drop all prefixes and call herself Mrs. Astor, as a late leader of New York society did. The wife of a son who is named for his father, is Mrs. Potter Palmer, Jr., as long as her mother-in-law lives and uses the name. The eldest daughter in a family is Miss Blair. The younger daughters, when they come out, are Miss Margaret Blair and Miss Marie Louise Blair.

**About
the Use of
Titles**

AS TO CALLS AND CARD LEAVING.

Authorities differ on the etiquette of cards and calling, but most of them advise us to use a little common sense when in doubt. If you remember that your card is yourself, you will know that you should not give it to the lady upon whom you are calling if she herself opens the door. Nor should you send it by the maid in houses where you are intimate, even if the maid is strange. Just give her your name and ask for the person you wish to see. In calling upon a new acquaintance, a lady may leave her own and her husband's cards on the hall table, to remind her of the name, address and receiving day. Cards should be left when a lady is not at home, one of each for the mistress of the house and one for the rest of the family.

Because formal calls and card leaving are simply civilities, like bows on the street—the small change of society—many people make the mistake of thinking them stupid and meaningless. But if you think a moment you will see that you can hardly invite anyone to your house until you have paid the compliment of a call, nor would you feel sure of welcome in a house whose mistress had not called upon you. A chance introduction does not establish an acquaintance. A call begins an acquaintance, one call a year continues it, and to cease to call or leave cards ends it, unless the obligation to call is cancelled by an invitation. Many ladies with a large visiting list, who find even one call all around, every year, too much of a tax, pay all debts except dinner calls and calls on new acquaintances, by giving a large reception or a series of teas.

**Reason for
the Formal
Call**

But if you call, you should go to see everyone on your visiting list once a year; you should go on each lady's receiving day, between three and six in the afternoon, or with your husband between eight and ten in the evening. Don't apologize for not having called before, nor stay over twenty minutes. On your own receiving day be at leisure, and don't keep a caller waiting without sending an apology. Don't fuss about a caller's belongings. A lady does not remove her wraps, and a gentleman can look after his own hat and cane. It is a pleasant English fashion to serve tea from four to five. This cordial custom puts people at their ease and makes one's receiving day popular.

WHO SHOULD MAKE THE FIRST CALL?

The older resident of a place should call on the newcomer to welcome her; the older lady on the younger one, for her position in society is of the greater dignity. Everyone owes a first call to the bride and to the new minister's wife. When there is no distinction of age or residence, either of two ladies may take the initiative. A first call must be made in person, and be returned in person within two weeks. A person who has been entertained at dinner must call on the hostess within one week. An unmarried man, of course, calls on ladies in person. He should ask for the mistress and master of the house, as well as for the young ladies. American society has passed the primitive stage of "Daisy Miller," whose mother apologized for coming into the parlor when Daisy had callers. If he finds people out, he should not turn down the corner of his card. It is understood that he has called in person.

If a maid says that her mistress is not at home, no caller should ask where she is or when she will return, unless very intimate or the matter is important. And don't take offense if you think some lady is at home. She may really be out, or else not properly dressed. In either case, she is not at home to visitors. The uncertainty on the point seems to make the conventional phrase more agreeable than if a lady is at home and sends word: "Mrs. Allen is engaged and begs to be excused." Some thoughtful ladies have the courteous habit of having maids say, "Mrs. Moore will be very sorry to have missed you. Her receiving day is Tuesday." In calling on a friend who is visiting people with whom you are not acquainted, ask for the hostess and leave a card for her. The acquaintance need not be continued.

CORRECT DRESS FOR LADIES.

When calling, in either the daytime or evening, a lady should wear her handsomest street gown, wrap and hat, a costume such as she would wear to church or an afternoon reception. Receiving in her own home, she should wear her prettiest house gown. A hostess should never outshine her guests. And this brings up the whole subject of suitable dress for all occasions. For ordinary street wear, nothing is in as good taste for a lady as a tailor-made suit. At an evening reception, dinner, dance or theatre, she should wear full dress

in any becoming color from white to black, and in any rich material from lace to velvet. A young girl's evening frocks should be light and simple, in dancing length, with elbow sleeves, and round or square necks cut out very little, if at all. Older ladies have their evening gowns trained and cut décolleté and practically sleeveless, if they wish. But many follow the example of Mrs. Cleveland when she was a bride in the White House, and veil the bust and arms in lace, net and chiffon. Jewels should be used with discretion. If a lady has a large collection of diamonds and pearls, she does not wear them all at once except at the charity ball, or an opening night at the opera. Then she is not so much an individual as a part of a brilliant picture.

PROPER DRESS FOR GENTLEMEN.

Correct dress is a simpler matter for a man than for a woman. It is impossible for him to overdress and he has a smaller chance to display bad taste. Men's fashions change less, and a really good tailor is a reliable authority that a man can consult as confidently as a woman can consult a good stationer in ordering her engraved cards and invitations. Up to six o'clock a man wears a business suit, ordinarily. For church, a day wedding, reception, luncheon, funeral or other ceremonious occasion, he wears a black frock coat, grey trousers and silk hat. For dinner and all evening entertainments, he wears a full-dress suit of black broadcloth. There are men who do not look well in the dress coat, and compromise by wearing the dinner or Tuxedo coat. With it should be worn the usual dress shirt and vest, pearl studs and white tie. The dinner coat is admissible at all but very formal affairs, such as the charity ball, and one's own "smart" church wedding.

Both men and women should observe unity in their clothing. It is very bad form for a gentleman to wear high shoes, a derby hat and a colored four-in-hand tie with evening dress. A lady does not wear her diamond necklace when she goes shopping, nor heavy walking shoes with a delicate trained gown to an evening party. It is in better taste to spend less on the gown, and have slippers, hose, gloves and hats that properly go with it. And it is better to have three dresses in the best materials, style and workmanship, than a dozen cheap and flimsy ones. Fashions change so often and so radi-

cally, in women's clothes, that women of wealth and position have much smaller wardrobes than used to be thought necessary. Even the bride fits herself out in dresses, hats and wraps only for the coming season.

WHOM SHALL WE INTRODUCE?

This is a mooted question. It is undisputed that a hostess may introduce guests under her roof, and most people think she is failing in courtesy if she does not do so. To make sure that everyone is introduced to everyone else, at an evening party it is the custom for the host or hostess to take each guest by the arm as she arrives, leading her about the room and presenting her to everyone in turn. This is awkward and embarrassing to the guest and puts a spoke in every wheel of talk. It takes a company several minutes to recover and nobody remembers anybody's name. In all European countries, being an invited guest under the same roof is an introduction, and in large cities in this country the custom is growing for people who meet in a house to converse freely with those nearest without previous introduction. A good hostess watches as guests form groups and talk, goes about among them and makes introductions incidentally. She may say: "I thought you would find Captain Clive congenial, Miss Deering, for he shares your enthusiasm for music." Thus introductions are robbed of stiffness.

At receptions, of course, where the hostess stands by the door to receive, callers are introduced to the guest of honor or the debutante as they arrive.

If anything, Americans are too generous and tolerant about giving introductions, and are apt to forget that people have a right to choose their acquaintances. If in doubt as to whether two people care to know each other, it is better to ask both, privately. A lady's permission must be asked in introducing a gentleman. In a way, you endorse the person you introduce, and you should be careful about whom you stand sponsor for. In England, if a young man should ask a lady to whom he is not well known to introduce him to a young girl, she may say without giving offense: "I am afraid I do not know you well enough to ask her mother's permission." And there we have one striking contrast to what is permitted in most places in America. It is astonish-

Care in

Making

Introductions

ing what a number of promiscuous young men acquaintances, who are unknown to her parents, a popular young girl can pick up. Girls should discourage the attention of young men who are unknown to their mothers and fathers. They can do this by the simple omission of an invitation to call at their homes.

On being introduced, people shake hands or not, as they choose. Two men usually do, and the hostess and host shake hands with a new acquaintance in their own home. But many people, especially ladies, shake hands only with near relatives and intimate friends. But if you do shake hands, do it heartily, with a firm clasp. A hard grip makes the victim wince, but a limp, flabby hand is about as pleasant to hold as a fish. A lifted arm, drooped finger tips and feeble wagging is an affected travesty that is, happily, going out.

**When and
How to
Shake Hands**

NEVER USE A FLIPPANT TONE.

A flippant "how-de-do" or a "happy-to-meet-you", said as mechanically as a talking doll would say it, do not recommend anyone to a new acquaintance. You are not required to say anything—a smile and a bow are sufficient—and an air of deferential attention is more eloquent than many words. If you do speak, say something simple and cordial. When you introduce two people, mention something in which both are interested, or make a graceful comment that starts the conversation naturally.

It is the gentleman's privilege to ask for an introduction to a lady, but it is the lady's privilege to ask a gentleman to call. It is a very great compliment for a mother with an attractive young daughter to say to a young man: "We shall be glad to see you in our home. My daughter and I receive every Tuesday."

ETIQUETTE OF VISITING FOR HOSTESS AND GUEST.

When guests are invited to stay in the house, it is now the custom to ask them for a definite time—a week, a fortnight, or a week-end—that is, from Saturday to Monday. A week-end house party in a large country house, where there is driving, motoring, boating, tennis, golf, skating or other out of door amusements, is a jolly affair. The guest should be told what train to take and then be met at the station. She should accept at once, go when she is expected, and leave when the limit of the visit is reached. In this day of many

interests and duties for women, a hostess pays you a compliment to ask you at all. She puts aside her other affairs and makes special plans for entertaining you. To postpone a visit or break the engagement for trivial reasons is the height of rudeness.

A well-bred guest is pleased with whatever is done for her pleasure and enters cordially into all plans made for her. Where people entertain a great deal the hostess is usually engaged until luncheon, as she needs time to rest and attend to her duties. A guest should appear promptly at meals, disarrange none of the habits of the family, nor ask extra attention from the servants. She should be blind and deaf to anything disagreeable that happens, and should not gossip afterwards about the hostess' private affairs. On returning home a note should be written immediately, thanking the hostess for a pleasant visit, and later something should be done in return for it. City people are delighted to visit the country, but far too seldom does it occur to them to invite their country friends to visit them in the city. Unwillingness to return hospitality is just plain selfishness and people who are guilty of it are properly rebuked by not being invited a second time.

**Show Your
Appreciation
of Hospitality**

The courtesies of a small and trivial character are the ones which strike deepest to the grateful and appreciating heart.

| HENRY CLAY.

Dinner Parties and Luncheons

The Severest Test of Social Talents—How the Table Should Be Set—The Guests and Their Places—Entering the Dining Room—Serving the Dinner—The Dinner Call—Settings and Service of the Luncheon.

To give a large, successful dinner party, with every detail in “good form”, is the severest test of a lady’s talents and social experience. The best preparation for this is to be used, from childhood, to properly served dinners, however simple, and to perfect table manners. The setting of the table is an art that takes a cultivated taste and a mathematical eye. When but one maid is kept, the mistress of the house or her daughter should arrange the family dinner table every evening. Women of wealth often prefer to train their waiting maids in this duty but they inspect the work and give the last touches when giving a dinner party.

The finest and whitest of dinner cloths should be used, and of a size almost to reach the floor. For round tables there are round cloths edged with heavy linen lace. The napkins are three-quarters of a yard square, carefully folded and not in fancy shapes, in ironing, with the worked monogram on the upper corner. The centerpiece of flowers should be arranged low so as not to hide guests from each other; and the lighting should be softly shaded, from candles evenly spaced on the table, or from a canopied electric light above. If gas is used, the ventilation should be especially good, for gas burns up oxygen. The silver, china and glass should be shining, and in delicate patterns and graceful shapes, even if not of an expensive quality. It is more interesting if the place plates and each course set is different, but a dinner set is more economical. White with gold edges never goes out of style because it harmonizes with all decorations and foods.

**The Table
and Its
Setting**

The places should be evenly spaced and all arranged exactly alike. In the middle of each is a place plate, to be removed when the first course is served; or there is a place card that any clever high school girl can draw and decorate. At the top of each place are arranged the spoons for the iced grape fruit, soup, dessert and coffee.

The napkin is placed at the right. Behind it is a small bread and butter plate, for bread, olives, etc. Butter is not served at a formal dinner. At the left is the dinner knife, and the forks placed in the order of their use—oysters, fish, roast, salad, game, dessert. If there is a second knife, it is meant to be used for separating bones from fish, or for cutting a green salad. Drinking glasses stand behind the forks in a row. Stemmed goblets, uniform in style but of graduated sizes, are most elegant for dinner use. Besides water, grape juice, Apolinaris and other temperance drinks may be served.

PLACING GUESTS AT TABLE.

Guests should arrive fifteen or twenty minutes before the hour named in the invitation. To fail to go when you have accepted, or to be late, is inexcusable, and one who offends in that way is not likely to be invited again. Think of that vacant place in the beautifully set table! The hostess tells each gentleman privately which lady he is to take out and sit next at table. The host leads the way with the guest of honor for the evening, or with the oldest or most distinguished lady. The hostess brings up the rear with the chief man guest. Host and hostess face each other from the ends or the middle of the sides of the table. The guests find their places by the names on the place cards and every one sits down in a gay flutter of talk and laughter. If the guests are well chosen this continues throughout the meal. A dull dinner party is a dreary bore. Conversation is general but each guest is especially responsible for entertaining his or her partner.

HOW DINNER IS SERVED.

When the guests sit down there is nothing on the table to eat except olives, nuts, mint paste, jellies, etc., and such things as are passed during the meal in sparkling little cut glass or decorated china dishes that add to the beauty of the table. The dinner may be a simple one, of four courses, or it may be elaborate. Any good cook book will give a variety of menus and the order of service. But whether simple or not, the courses are served on the plates, by the butler or waitress, from the pantry. Vegetables and small dishes are passed to the left, for the guests to help themselves. They are put directly on the plate, small sauce dishes not being used as savoring of hotels and restaurants. No carving is done at the table, except

the turkey at a family Christmas dinner. This leaves the host and hostess as free to enjoy themselves as the guests.

One may omit any course, but should not refuse to be served. If he trifles with the food and is interested in the talk, no one notices that he is not eating. No one should ask for a second helping of anything. This keeps everyone else waiting. If a hostess is obliged to speak to a waitress she should catch her eye and speak low. For her to rebuke a waitress before guests is ill-bred, because it humiliates the girl and makes everyone feel uncomfortable. If a guest should upset a glass of grape juice or a cup of coffee, the hostess should be stone-blind to the accident. A trained waitress will come along casually and lay a napkin or doily over the stain. The hostess should not notice any delay or mistake in the service. A strike may be threatening in the kitchen but she is serene.

**Things
That May
Happen**

A dinner of many courses, eaten leisurely, may take two or three hours to serve. That is a visit in itself, and guests may not remain more than half an hour in the drawing room. However, it is best for one to wait until the party breaks up, before going. Thank your hostess for a pleasant evening, but don't thank her for the dinner. Shake the host's hand and bow yourself out. Then pay your dinner call within one week.

THE LADIES LUNCHEON.

A ladies' luncheon is similar to a dinner except that it is given about one o'clock, is not so heavy, and the polished table is only partially covered with a handsome centerpiece, tray cloth and doilies under the plates and glasses. From three to five courses are sufficient. Often the ladies keep on their hats and simply remove their gloves at the table. A luncheon in a down-town tea room, followed by a matinee party to some popular play, is a delightful way for a chaperon to entertain several young ladies.

*We should be as courteous to a man as
we are to a picture, which we are willing
to give the advantage of the best light.*

—EMERSON.

Good Form in Correspondence

Color of Letter Paper—Monograms and Embossing—About Your Handwriting—Asking Favors of Strangers—The Form of Letters—The Signature—Eccentric Ways of Writing—Position of the Stamp.

Everyone has occasion to write letters and notes of business, friendship and courtesy, and should be supplied with proper materials. Paper, ink and pens of the best quality are not expensive, and it is in bad form to use anything else. Postal cards are correct for impersonal messages and business notes; linen writing pads, with envelopes to fit the folded sheets, are convenient for generous family letters, but ruled lines are barred for any purpose. For social correspondence note paper, of which there are three sizes, in cream-laid or white linen bond paper, is first choice. If you wish to have something individual that friends will always recognize as yours, it is in good

Style of the Stationery taste to use the thin foreign paper, or to select a French grey or delicate robins' egg blue. And you may have your address engraved for the top of the sheet, or your initials or monogram stamped in the upper left-hand corner from a carefully-made die. Black lettering is always in good taste, but dark blue looks better on light blue, moss green or silver on French grey and gold on cream. Or the letter may simply be embossed—raised—on a heavy quality of paper and left uncolored. You should tell the stationer if you want the address or monogram on the first page or the fourth. For notes of one page or a slight turn over, a touch of elegance seems to be given by beginning on the last page.

A business or other formal letter should be typewritten, if possible. But social letters and notes must be written by hand. While handwriting should have character and style, and not appear like a copy-book, it should not be freaky. Few people are fond of making out Chinese puzzles. Especially should names and addresses be plainly written. Some people apparently cultivate signatures that might be "Nebuchadnezzar" or just "John Smith." The date and the writer's full address should

always be written in the upper right-hand corner of the first page. For notes it is better form to spell the month and day out in full. In writing to a stranger about your own affairs, if you want an answer, you should enclose a stamp or a stamped and self-addressed envelope. No one puts a stranger to expense in matters that do not concern him.

FORMAL AND SOCIAL LETTERS.

A formal letter should be begun with the full name and address of the person written to, thus: "Mr. Lawrence Bassett, 171 LaSalle Street, Chicago, Ill.", arranged compactly in three lines at the left. Below is "Dear Sir," or, it is good form to begin a business letter directly without "Dear Sir" or "Dear Madam", and then put the name and address of the person written to at the end, below and to the left of your own signature. "Dear Sir" is the formal style, but "Dear Mrs. Owens" or "Dear Alice" is familiar and is used only in writing to friends. If Mrs. Owens is only an acquaintance, she should be addressed as "My dear Mrs. Owens". A business letter ends with "Yours very truly," "Yours respectfully" or some other courteous expression. "Very sincerely yours" is warmer but is properly used with business houses with which one has been on long and good terms, with acquaintances and with friends. With relatives or intimate friends, one should use "Affectionately yours", "With love" or any term that correctly expresses your real feelings. The full name should be signed at the end. A married woman signs her own name, thus: "Margaret Boyd Monroe". If the letter is to a stranger who does not know how to address her, she should put [Mrs. John Dixon Monroe] in brackets below and to the left of her signature. An unmarried woman indicates the fact by putting [Miss] in brackets before her name. Any woman, married or unmarried, is addressed as "Dear Madam" in a letter, by a stranger.

**The
Beginning and
the End**

A letter should be begun on the first page of the sheet, and the pages should be used consecutively. To skip around is freaky, and confusing to the reader. The paper should not be turned, with the writing across on one page and up and down on the next. Nor should one write in small characters all around the margin. The only thing that is more irritating is a "plaid" letter, where the page

is covered twice, in opposite directions. No one is so poor that he must pay his friend so shabby a compliment.

And if you think twice before speaking, think five times before writing. Don't write anything that you may have to explain or that you are likely to regret. The letter that a writer asks to have burned is usually the one that is carefully preserved. And remarks that are jokes in talk, when the merry eye and smiling lips warm them, are often wounding on cold paper. Don't try to do fine writing. Write simply and sincerely as you would talk, say only what you mean, but be sure never to put anything ill-humored or discourteous on paper. And each letter should be answered in kind—a formal letter formally, a friendship letter cordially. This is the only way in which you can treat the friends who are far away from you as courteously as you do those who are near. Christmas letters, notes and cards are really long distance calls.

Letters of introduction and messages carried by friends should not be sealed. Seal all other letters securely, but do not use wax unless you are expert in its use. In addressing a letter put the full name on one line, the street number and the street on the line below and the city and abbreviated state on the third line. For a small place, the town, county and state are the proper order. Have them all compactly arranged, on the lower half of the envelope, neither crowded nor sprawled. On a registered or special delivery letter or package, the sender's name and address should be plainly written in the upper left-hand corner. A letter meant for a particular person, in a business office, where it may be opened in the routine work of a clerk, should be marked "Personal" in the lower left-hand corner. Of course, no one opens any one's private letter in a family.

Put the stamp in the upper right-hand corner, where it is the most convenient for the mail clerk to cancel. And set the stamp right side up. In England, it is thought to be an act of gross disrespect to turn the king's head upside down. We should feel the same way about Washington, Lincoln and other national heroes whose heads appear, beautifully engraved on our stamps. Any act, however small—as the putting on of a stamp—that is careless or thoughtless or slovenly or undignified, is bad manners.

Now, if you will re-read the opening paragraphs of the first article on good manners, you will be able to think out the reasons that lie back of all the social observances that go to make up "good form". Back of the wish to give pleasure and not pain to others, lies unselfishness, kindness. Back of simplicity, naturalness in manner and speech lie self-respect, that feels no necessity of appearing to be other than a man is. Behind serenity that is not to be surprised or vexed or offended lie self-control and personal dignity. Back of ease and tact and unfailing civility lie kindness and self-forgetfulness.

"A gentleman makes no noise, a lady is serene," says our great gentleman, Emerson. Behind really good manners lies spiritual beauty and moral worth. Do not doubt it, although it is true that people of no beauty or depth of character often observe all the rules of polite society through policy. Aren't you glad they do? Think how unendurable they would be if they did not. And continual practice of good manners cannot but improve their minds and hearts. And those who think that, in a democracy like ours, all men are equal should remember that equality applies only to political rights and the opportunity to rise. The constitution opens the door of no man's house. Socially, one man is as good as another only if he behaves as well.

*Good breeding is benevolence in trifles,
or the preference of others to ourselves in
the daily occurrences of life.*

—LORD CHATHAM.

Etiquette of the Invitation

Wedding Invitations and Announcements—The Reception—Invitations to a Debut—For a Private Dance—Dinner Invitations—Ladies' Luncheons—Garden Parties—Wedding Anniversaries—Complimentary Cards

Invitations to all formal entertainments should be printed from engraved plates. For weddings and other large affairs of ceremony, the wording is in the third person. The wedding invitation and announcement are on heavy cream-laid note paper that folds once, is enclosed in an inner and outer envelope, and is usually sent by mail. The lettering is in script or in old English or German text, whatever is the fashion of the moment. The following is the proper arrangement:

Mr. and Mrs. George W. Wilson
request the honour of your presence
at the marriage of their daughter
Ina
to
Mr. Nelson S. Moore
on Saturday evening, the seventeenth of September
One thousand nine hundred and ten
at half after seven o'clock
Congregational Church
Morton Park, Ill.

A small card may be enclosed on which is engraved:

*Please present this card
at the First Presbyterian Church
Twenty-first Street and Indiana Avenue
on Thursday, the seventeenth of June*

This is to keep out people who are not invited. A second small card reads:

*Reception
immediately after the ceremony
353 East Forty-sixth Street*

No answer is required. One who is invited accepts by attending. If unable to go, the personal cards of those invited should be mailed to the bride's father and mother, since they issued the invitation, to arrive the morning of the ceremony. An invitation to a wedding breakfast or supper should be accepted or declined at once, because a seat is reserved at the table. The note should be written on note paper, in the same formal style, thus: "Mr. and Mrs. Ralph Payne accept with pleasure the kind invitation of Mr. and Mrs. William Ellery Bond to the wedding breakfast of their daughter Marguerite, on Wednesday, June Fifth."

On returning from the wedding journey a newly married pair send out their joint card, to notify friends of their new address:

Mr. and Mrs. Edward Clement Henrotin

*At home
after the first of June*

*South Berlin
New York*

THE WEDDING ANNOUNCEMENT.

A wedding announcement is sent out to all acquaintances in case

a small home wedding was given, and only relatives and very intimate friends were invited to the ceremony. Following is the form:

Mr. and Mrs. Charles W. Brown
announce the marriage of their daughter
Winnifred
to
Mr. Harvey F. Clover
on Monday, June the tenth
One thousand nine hundred and twelve
Chicago

People in the same city who are honored with the announcement card should call. Those who live elsewhere should write congratulations.

CARDS FOR A DEBUTANTE'S RECEPTION.

Following is the form of invitation to a debutante's reception:

Mr. and Mrs. Charles S. Bartholf
Miss Dorothy Bartholf
request the pleasure of your company
on Friday evening, January the third
at half after eight o'clock

Music

Morningside
Glencoe

This is engraved on a square, or nearly square, card that fits the envelope. If the reception is given in the evening, the invitation is issued in the names of the host and hostess. If the letters R. S. V. P. appear on it, they mean that an answer is requested. These letters are an abbreviation of four French words meaning "please reply." The tendency is toward greater simplicity in the use of language and "please reply" is frequently used as:

To meet

Major General and Mrs. Grant

Mr. and Mrs. Cyrus H. M. Cormick
request the pleasure of

company at luncheon
on Saturday, June the fifth
at two o'clock

Please reply
Walden, Lake Forest

This form of invitation is suitable for any reception. If it is given for a lady who is visiting from another city, her name appears below that of the hostess, as the guest of honor.

A PRIVATE DANCE.

Mr. and Mrs. Robert Livingston
request the pleasure of the company of
Mr. and Mrs. Phillip Schuyler and the
Misses Schuyler

On Thursday evening, December Twenty-first.

Cotillion at ten

R.S.V.P.

Here, engraved forms are used, with a blank space left for names of guests. An answer is required. No one speaks of a private dance as a ball. The word is reserved for large, semi-public dances. When people entertain often at dinner, engraved forms are kept on hand,

the names of the guests being filled in. But if the guests at dinner are few, many ladies write notes of invitation. If a large formal dinner is given the third person is used.

*Mr. and Mrs. Worthington Smith
request the pleasure of
Mr. and Mrs. Heath's company at dinner,
January ninth, at seven o'clock
159 Lincoln Parkway.*

The dinner invitation is usually sent by messenger. A reply should be written at once and in the same style, stating that "Mr. and Mrs. George Heath accept with pleasure the polite invitation of Mr. and Mrs. Smith to dinner on the ninth of January, at seven o'clock," or "regret that a previous engagement deprives them of the pleasure, etc."

To intimate friends an informal note may be mailed:

Dear Mrs. Heath—

Mr. Smith and I would be glad to have you and Mr. Heath dine with us on Tuesday, January the ninth, and to meet my friend Miss Ritchie, who is visiting us, from Denver. The party will be small and full dress is not required.

Sincerely yours

Frances Lee Smith.

A LADIES' LUNCHEON.

*Mrs. Seymour Howard
requests the pleasure of
Mrs. Avery's company at Luncheon,
February twelfth, at one o'clock,
67 Riverside Drive.*

In honor of Mrs. William Dean of Los Angeles.

An answer, in the same style, should be sent immediately.

A GARDEN PARTY AT A SUBURBAN HOME.

*Mr. and Mrs. Edward Brewster, Jr.
request the pleasure of
Mr. and Mrs. Howard's company
on Thursday,
July twenty-seventh,
at four o'clock.*

Garden Party.

Lakewood, New Jersey.

Carriages will meet the train arriving from New York at 3:45.

This is a reception on the lawn, with refreshments *en buffet*, under a tent or on a veranda. No answer is required, but if unable to go you should send card. Do not write "regrets" on the card, nor anything else.

WEDDING ANNIVERSARIES

1885

1910

*Mr. and Mrs. Hamilton Blair
request the pleasure of your company
on Thursday, June twenty-fourth,
at eight o'clock.
Silver Wedding.*

Hamilton Blair.

Caroline Ellis.

This should be printed in silver, on white; for the golden wedding, in gold. The form is the same for all wedding anniversaries. The two dates appear in the upper corners, the name of the bride and groom in the lower. If one wishes to do so a line may be added: "No presents." The affair is a reception with a buffet supper, music and flowers, and is usually very happy and gay.

Invitations to teas, card parties and small affairs are often written on the personal card of the hostess.

COMPLIMENTARY CARDS.

Introductions may be made in a gracefully written note, or by writing on one's visiting card: "Introducing Miss Eleanor French." The card may be presented in person, or mailed, with the holder's card, if she is visiting in a strange city. The lady to whom the introduction is sent should call on the lady introduced, or invite the stranger to her house.

Complimentary invitations to weddings and receptions are sent to families in mourning, but not to dinners or luncheons. No replies are expected, nor return of courtesies for a year.

In announcing the birth of a child, a tiny card, engraved with the name of the baby, and the date in the lower left corner, is tied with white baby ribbon, through perforations, to the larger card of the parents, and mailed in an envelope that fits the card, to all acquaintances. This is properly answered by the personal card on which may be written anything appropriate.

A card should always be enclosed with a gift of flowers, books, bonbons, etc., and should be gracefully acknowledged.

THE BOY SCOUTS


I believe the treatment you have accorded the subject will be both interesting and instructive. It should prove readable and understandable to all classes and ages of readers.

Geo. H. Merrill

SECRETARY EDITORIAL BOARD, BOY SCOUTS OF AMERICA.

"Scout" used to mean the one on watch for the rest. We have made the scout an expert in Life-craft as well as Wood-craft, for he is trained in the things of the heart as well as head and hand. Scouting we have made to cover riding, swimming, tramping, trailing, photography, first aid, camping, handicraft, loyalty, obedience, courtesy, thrift, courage and kindness. Whether you be farm boy or shoe clerk, newsboy or millionaire's son, your place is in our ranks.

Ernest Thompson Seton



CHIEF SCOUT.

A few years ago a committee of boys canvassed a city neighborhood to raise a small sum of money to be used in fitting up a club room. The first man they approached was a merchant who had been born on a pioneer farm. When the boys explained that they needed a gymnasium for their physical development, and a room for quiet games and reading in the evenings, the old man glared at them.

"Need exercise, do you? Go and saw wood for your mother."

Those twentieth century boys laughed. They lived in tiny cottages on twenty-foot lots, or in small flats in big tenement buildings. Not one of them had ever seen a stick of wood to burn, nor a garden to hoe and weed, nor a cow to milk.

"Then get a job in a store. I was sweeping out a country store and building the fires when I was twelve years old."

"A boy isn't allowed to work now, until he's fourteen, and not a full day until he's sixteen," said the spokesman.

HOW IT USED TO BE WITH BOYS.

"Well, well, I guess that's so, and the work now is done in factories instead of out-of-doors, and it isn't good for a boy to be shut up. It was worth while being a boy fifty years ago. I could ride a horse to water, carry in wood, and drop corn behind a plow when I was four years old. At ten I could curry a horse, clean a stable, milk a cow, saw wood, hoe the garden and turn a grindstone. I could ride and shoot and swim and fish and go on snow-shoes like an Indian; and find my way in the woods by blazes on the trees, and by the stars, catch and cook my own supper and make a good shelter and bed. I knew all the wild plants and birds and animals. A boy had to rely on himself in those days and be of use to others, and it made a man of him. The good old chores and sports are all gone. No wonder the boys are good for nothing. I'll have to look into this."

HOW IT IS WITH BOYS TODAY.

He did look into it. He found, as every other man and woman who has investigated the matter has found, that the conditions of living have all changed, and that boys and parents are equally the victims of circumstances. Aside from the hours in school the growing boy has no duties. No real use can be made of him in the home. Living quarters are so cramped that the street is his only playground. There he has nothing to do that is interesting or important, nothing to play with. There is nothing that he can get by his own exertions, not even innocent fun. So he loiters around saloons and cheap theatres, is educated in evil, spends money that he does not earn, reads yellow newspapers and vicious books, smokes cigarettes, joins a "gang" to satisfy his love of adventure, and gets into trouble with the police. In a word, he degenerates physically, mentally and morally. And yet, at heart, the boy is the same as the sturdy, honest, useful boy of an early day. All he needs is a square deal—the space, the freedom, and the healthy outlet for his energies.

ORIGIN OF THE BOY SCOUTS.

The idea which underlies the Boy Scouts is not one which originated with any one man or set of men. For years men have been

working with boys—some in one way and some in another. Ernest Thompson-Seton, the naturalist, worked with boys along the lines of woodcraft and Indian life. Dan Beard, the illustrator and well-known author of boys' books, simultaneously was working with boys along the lines of pioneering, handicraft and out-door life. Byron W. Forbush, Ph. D., was also dealing with boys along the lines of hero worship and in imitation of the knightly life that centered around the Round Table of King Arthur. In the Young Men's Christian Association, Edgar M. Robinson was standing for the four-fold development of the boy and for the boy's education for the duties of life and citizenship. Thomas Chew, the President of the Federated Boys' Clubs and the Superintendent of the Fall River Boys' Club, was working with a large number of boys along social and moral lines. Besides these, a whole host of others in the social settlements and playgrounds were touching the lives of boys for the purpose of making better men. The idea that underlay the work of all of these men was the same, but they differed widely in the conception of the idea and the method of its application.

Lieutenant-General Sir Robert S. S. Baden-Powell, K. C. B., stirred by the sight of forty-six per cent of all the boys in England growing up without adequate knowledge of any useful occupation, made a study of all the methods for helping boys already in the field, and connected them together by an appeal to boys for service to the community.

The General, in an address at a banquet tendered to him in New York, said:

"You have made a little mistake, Mr. Seton, in your remarks to the effect that I am the Father of this idea of Scouting for boys. I may say that you are the Father of it, or that Dan Beard is the Father. There are many Fathers. I am only one of the Uncles, I might say. . . . The scheme became known at home. Then it was that I looked about to see what was being done in the United States, and I cribbed from them right and left, putting things as I found them into the book."

The Boy Scout idea, then, originated in America, and it is most fitting and appropriate that we Americans should be its most enthusiastic supporters, since this country of ours is not merely its birth-place, but is the country above all others in which it should grow the fastest and do the most good.

THINGS THE BOY SCOUTS DO



E.T.S. 1100

How Boy Scouts study tracks: Tree bird and bird living partly on ground. Which is which?



Ernest Thompson Seton, General Baden Powell and Dan Beard, Scout "Fathers."



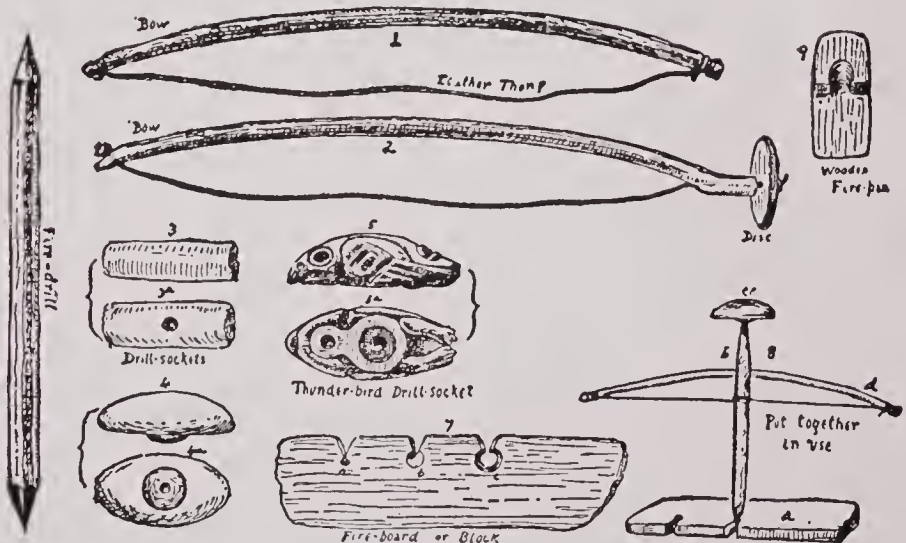
Position of right hand in taking the oath



Patrol badges. The upper is the badge of the "Blue Herons," the lower of the "Blue Buffaloes."

Boy Scouts make a fire with rubbing-sticks in from five to ten minutes. Pass leather thong taut around drill; put lower point of drill in pit at top of notch in fire-board and hold socket with left hand. Fire-board notch should rest on a chip or thin wooden tray (9). Hold bow by handle end in right hand, steady board under left foot and left arm against left knee.

Draw bow back and forward, full length, with steady, even strokes. Ground-up wood will run out of side of notch, falling on tray. At first it is brown, in two or three



Drawn by Ernest Thompson Seton.

HOW TO BUILD A FIRE WITH RUBBING STICKS.

Illustrations Copyrighted by Boy Scouts of America

THINGS THE BOY SCOUTS DO

seconds black, and in five or six seconds gives off cloud of smoke. Then fan gently with hand and in a few seconds you will see a glowing coal in the middle of dust. Take about a teaspoonful of shredded cedar wood, previously prepared, wrap it in bark fiber or shredded rope, hold it on coal, and lifting tray and all, blow it until it blazes. Carefully add birch bark shreds or pine splinters, and your fire is made!

Figure 1 is a simple bow—a bent stick, about 27 inches long and $\frac{5}{8}$ inch thick, with stout leather thong. In No. 2 thong at handle end goes through disc of wood to tighten by hand pressure against disc while using. Figs. 3 and 4a show drill sockets. No. 5 is a fancy one. Here (4-4a) is a soapstone socket let into wood and fastened with pine gum. Top of drill should be greased before using. It should be 12 to 18 in. long and about $\frac{3}{4}$ in. thick, roughly eight-sided so thong will not slip. Best drill wood is old, dry brush, but basswood, white or red cedar, tamarack, and sometimes even white pine, will do.

MERIT BADGES AND HOW THEY ARE WON.



To win a Merit Badge a Scout must show that he knows certain things and that he can apply his knowledge. To win an electricity badge, the first shown on left, he must, among other things, illustrate, by experiment, the laws of electrical attraction and repulsion and name three uses of direct and tell how it differs from alternating current.



MACHINERY BADGE: State principles underlying use and construction of lathe, steam boiler and engine, drill press and planer.



MINING: Know and name fifty minerals; define watershed, delta, drift, fault, glacier, terrace, stratum and dip.



ORNITHOLOGY: Identify by appearance or note forty-five different kinds of birds in one day and make a good clear photograph of some wild bird.



PHOTOGRAPHY: Understand theory and use of lenses, construction of camera, and action of developers; make a recognizable photograph of any wild bird larger than a robin, while on its nest; or a wild animal in its haunts; or a fish in water.



PUBLIC HEALTH: Draw diagram showing how flies carry disease; how to co-operate with the Board of Health in preventing disease; describe garbage disposal.



PERSONAL HEALTH: Describe care of teeth, proper eating and effect of alcohol and tobacco on growing boys.



AVIATION: Know theory of aeroplanes, balloons and dirigibles; describe various types of aeroplanes and their records.



AGRICULTURE: Identify injurious insects and tell how best to handle them; have a general knowledge of farm work and of dry farming and irrigation.

CIVICS: Know how president, vice-president, senators and congressmen are elected, the various departments of government as represented in the president's cabinet.

The movement has now spread over all the world and has enrolled hundreds of thousands of boys. But it is most active in America and England and all the English-speaking colonies. There are several hundred thousand members led by many thousand Scout Masters. Most of the National departments, many of the states and all of the big public movements are actively co-operating with the Scout movement.

WHAT THE BOY SCOUT MOVEMENT MEANS.

The impression that many people have, that the real purpose of the Boy Scout movement is to train future soldiers, is wrong. It is intended first to give the boy, deprived by modern industry of his ancient rights, a square deal, to fill his vacant or mischievously employed hours with healthy, absorbing interests; to give him a better developed body, more acute senses, a more alert and resourceful mind, and to help him grow up into a more useful, responsible man and patriotic citizen. No guns, swords, gauntlets, whips, spurs or any purely military equipment are allowed, and no military drilling is prescribed. Target shooting with a bow and arrow, that a boy may make for himself, is encouraged. But he stalks game only with an opera glass, and takes shots only with the photographic camera. Honors are for feats of skill, results of serious study and deeds of humanity. They are to be won only by courage, industry, strength and honesty. Every badge stands for clean living and sustained effort.

HOW TO BECOME A BOY SCOUT.

With the boy who reads this the first question would naturally be: "How can I become a Boy Scout?" There is no difficulty about it, for it is desired to enlist as many boys as possible. Information and practical help are freely given, on request in person or by letter, at the National Headquarters, which are located in New York City. There are Scout Councils in all the large cities in the country, and in many populous towns and counties; and local committees are being established in villages and city districts. The official handbook of The Boy Scouts of America is to be found or ordered in any bookstore, and is on the shelves of most public libraries. Any boy, anywhere, who is between the ages of twelve and eighteen, can easily learn how to get into touch with the nearest local Scout Council, and how to join, or even to form a new patrol. But usually a new patrol is

formed by a young man who is interested in being a big brother to younger boys. He applies for an appointment as Scout Master, qualifies for the position and then acts as a recruiting officer to enroll and train a patrol. He can work in his leisure hours, with any group of boys, in any place most convenient for him and them. There are boys everywhere who are eager for the fascinating work and play.

Scout patrols may be formed either with or without connection with some religious or educational institution. The easiest way to become a Boy Scout is to join a patrol that has already been started. These patrols may be in a Sunday School, a Boys' Brigade, a Boys' Club, a Young Men's Christian Association, a Young Men's Hebrew Association, a Young Men's Catholic Association, or any other organization of a like nature.

A patrol consists of eight boys, one of whom becomes the patrol leader and another the assistant patrol leader. A troop consists of three or more patrols, and the leader of the troop is called a Scout Master. There can be no patrols or troops of Boy Scouts without this Scout Master.

There are three classes of scouts among the Boy Scouts of America—the Tenderfoot, the Second-class Scout, and the First-class Scout. Before a boy becomes a Tenderfoot he must qualify for that class. A Tenderfoot, therefore, is superior to the ordinary boy because of his training. To be a Tenderfoot means to occupy the lowest grade in Scouting. A Tenderfoot, after serving one month and meeting certain other requirements explained further on in this article, may become a Second-class Scout, and a Second-class Scout, upon meeting another set of requirements, may become a First-class Scout.

A boy becomes a Tenderfoot when he knows the history of the United States flag and the customary forms due it; when he knows the Scout law, sign, salute and significance of the badge; and when he can tie quickly and efficiently four out of nine most common standard knots. Having successfully passed such a test, the boy takes the Scout oath: "I promise, on my honor, I will do my best: 1. To do my duty to God and to my Country, and to obey the Scout Law. 2. To help other people at all times. 3. To keep myself physically strong, mentally awake, and morally straight."

There are twelve elements of the Scout law which the boy promises to obey and uphold. He must do his best to be trustworthy,

loyal, helpful, friendly, courteous, kind, obedient, cheerful, thrifty, brave, clean and reverent.

THINK OF ALL THAT SCOUT OATH MEANS!

Honor, duty, reverence, patriotism, self-sacrifice, obedience, all in that simple promise! Those are things that boys often consider very little. The full text of the Scout's Law obliges the boy to tell the truth; to obey his father and mother, his own leader and officers of the law; to help others even at risk to himself; to look upon all other people as his brothers and equals; to be like Kim in Kipling's story, "The little friend of all the world." He promises to look out especially for old people, cripples and little children; to take no reward for kindness; to befriend animals and protect them from abuse; to do his duty cheerfully, and not grumble or whine; to "grin and bear" disagreeable things and go about smiling and whistling; to use no profane or vulgar language, and to save his money.

A boy who has been idle, thoughtless and evil-minded breaks with his past and burns his old bridges on becoming a Boy Scout tenderfoot. He stands on a new moral plane with the public opinion of his companions to keep him up to the mark. Besides, he immediately has interesting things to think of and to do. He discovers new powers in himself that increase his self-respect. Then he goes into training for the rank of second-class scout, and that involves real work.

THE BOY SCOUT'S UNIFORM.

A uniform is not necessary, but it is advisable. All boys love uniforms, decorations and display. It is a very attractive outfit, all of an olive drab khaki, semi-military, semi-sporting in style. There is a flat-brimmed army hat of olive drab felt, with or without chin tie, a khaki flannel shirt and a sweater, knee breeches of the same material as the shirt and coat, a leather or web belt, puttee leggings, and a haversack. The usual articles carried are a 6 1-2 foot staff, a lanyard, a knife, a canteen, axe, poncho and whistle. A very limited camp outfit or cooking kit consisting of a coffee or tea can, stew or fry pan with cover, and one boiler with two handles may be carried in the haversack. There is a badge for the button hole, the scroll motto, "Be Prepared," a shoulder knot of the patrol colors, a neck kerchief of the troop colors and special "honor" badges for the sleeve. It is a rough and ready uniform and outfit but as inexpensive and serviceable as possible, neat and smart, and it stands for so much skill and general

knowledge and moral discipline and fun that a boy is very proud of the privilege of wearing it.

THE CLUB ROOM AND HOW TO FIT IT UP.

One of the first things a patrol usually does is to find a club room. Such a room is not always absolutely necessary, as the boys may meet in one another's homes for such occasions when the troop or patrol meet, but a special room proves an excellent thing to have for troop and patrol meetings, where the whole group of boys can get together every so often and feel that each has a common ownership in the place. Very often the use of a vacant store or barn may be had for nothing. The boys themselves should clean the place and make it attractive; soap and kalsomine are cheap. Most boys now have manual training in school and can make tables, benches, stools and book shelves of packing cases, staining them in dark colors, or they can repair old furniture that may be donated. There should be a stove and good lamps or some other means of heating and lighting. The ingenuity and resourcefulness of the boys can be used in finding things such as flags, rugs, cushions and lithograph prints to make the club room attractive. The more the club room costs in time and effort, the more it will be appreciated by the boys. A small fee should be paid each week by every member to cover the cost of fuel and oil, but the boys, according to the Scout principles, should earn the money themselves for such expenses.

OTHER THINGS THE SCOUT MUST DO AND LEARN.

He must serve one month as a Tenderfoot. He must learn, by text-book study, and by actual practice on his mates or at home, how to give elementary first aid to the injured. He must learn elementary signaling, by the Semaphore, American Morse or Myer alphabets. He must be able to track one-half mile in twenty-five minutes, and be able to name and describe satisfactorily the contents of one store window out of four observed for one minute each. He must be able to go a mile in twelve minutes at Scout's pace—about 50 steps running and 50 steps walking alternately. He must lay and light a camp fire, using not more than two matches, and know the proper use of knife or hatchet. He must earn and deposit at least one dollar in a public bank. He must be able to cook meat and potatoes over the camp fire with the simplest camp kit; and he must know the sixteen principal points of the compass.

THE NAMES AND CALLS.

Each new patrol of each troop selects a color and a name. The name is that of some bird or animal after the Indian fashion, and the one chosen becomes their "totem" name or patrol animal. Thus a patrol is known as "Wild Cats," "Otters," "Beavers," "Buffalos," "Wolves," or anything the patrol members decide upon. Each Scout in a patrol should be able to imitate the call of his patrol animal. Thus the Scouts of the Wolf Patrol should be able to imitate a wolf. In this way Scouts of the same patrol can communicate with each other when in hiding or the dark of night. It is not honorable for a Scout to use the call of any patrol except his own. The members of each patrol are distinguished from those of other patrols by their colors, which are worn upon the left shoulder in a shoulder knot.

Each troop of Boy Scouts is named after the place to which it belongs, as for example, Troop No. 1, 2, 3 or 4 of New York or San Francisco. Each Scout in a patrol has a number, the patrol leader being No. 1, the assistant patrol leader No. 2, and the other Scouts the remaining consecutive numbers. Scouts in this way should work in pairs, Nos. 3 and 4 together, Nos. 5 and 6 together, Nos. 7 and 8 together. The patrol leader calls up his patrol at will by sounding his whistle and by giving the call of the patrol. Each patrol leader carries a small flag on the end of his staff with the head of his patrol animal shown on each side.

When the Scout makes signs anywhere for others to read he also draws the head of his patrol animal. This is to say, that if he were out scouting and wanted to show that a certain road should not be followed by others, he would draw the sign "not be followed" across it and add the name of his patrol animal in order to show which patrol discovered that the road was bad, and by adding his own number at the left of the head would show which Scout had discovered it. For such purposes the Scouts are also supposed to know the different Indian and Scouting signs.

HOW THE RANK OF "FIRST CLASS SCOUT" IS WON.

To win the rank of first-class scout, a boy must pass ten more hard tests. There are higher requirements in money saving, life saving, athletics, camp cooking, map-making and reading, judgment of size, direction and distance without instruments, knowledge of nature,

signalling, manual skill in wood or metal working. And he must enroll and train a tenderfoot.

All this involves indoor and outdoor work, text-book study and outdoor practice. As quickly as possible a patrol should take the trail into an open field, an orchard or a park, and each time with some definite object in view. But that object should be accomplished in a variety of ways. The boys should be given their heads, although always accompanied by an adult leader, and should be encouraged to invent sports and to carry out their ideas with spirit.

To a boy a pond or lagoon easily becomes the high seas, a clump of trees Robin Hood's forest. An open space is a prairie covered with buffalo. Through an orchard boys will steal, single file like Cooper's Indians. To find their way by the stars, by landmarks and signs, adds both to their knowledge and to their pleasure.

HOW THE HONOR BADGES ARE WON.

The rank of First-class Scout is the highest in Scouting, but a boy can go in for various merit badges and honors, for which there are specific requirements outlined in the boys' Handbook or Manual. He can win badges for Agriculture, Architecture, Astronomy, Carpentry, Civics, Firemanship, Life Saving, Photography, Seamanship, Surveying, or as an Electrician or Musician. Each one involves study, practice and examinations. Signaling alone involves a study of telegraphy or reading signals by sound, of the semaphore and heliograph, and of the different smoke and fire signals.

The Official Handbook of the Boy Scouts of America gives requirements for 57 different merit badges and outlines the study and work. There is a special handbook upon the methods of passing these requirements, and the exact knowledge which is necessary therefor. Also, as part of the boys' Handbook, there are several chapters of general knowledge, by Mr. Seton on Woodlore; by Dr. Dall on Shellfish; Dr. Smith on Fishes and Angling; Dr. Corbett on Flowers; Mr. Gibson on Campcrafts and Hiking; Mr. Seton on Trailing and Signaling; Dr. Fisher on Health; Mr. Alexander on Chivalry; Mr. Sherman and Col. Roosevelt on Patriotism and Citizenship; Majors Lynch and Longfellow on First Aid and Life Saving, besides a number of other contributions by well-known authors.

Many of these things are learned and practiced in games that have been invented to copy the real work of the Indian, the pioneer

and the army scout. With dummies there are deer and bear hunts, fishing for sturgeon and whales, canoe tag, games of quick and far sight, spot the rabbit, man hunt, spy in the camp, tree the coon, feather blow, fire-fly dance, lion hunt, raid the flag, throw the assegai, track the thief, snow fort, man hunt, smugglers over the border and countless other games.

YOU CAN BE A SCOUT ALL YOUR LIFE.

Once a Scout, a boy can remain in the organization as long as he lives. Joining at twelve years of age, he can rise in rank, becoming an assistant patrol leader, a patrol leader, a troop leader, and as he passes the age of 18, an assistant Scout Master, then a Scout Master, a Councilor or a Commissioner. As a man he can give as much or as little time to the work as he chooses, and train one patrol after another; and that is just what is wanted—boys who will remain in the work when they grow up and help save future generations of boys. Money is not needed so much as human service. The expense is kept at a minimum, and each patrol or troop takes care of itself, with the aid of the Scout Master or Local Council. The less boys are helped from the outside, the more self-reliant and resourceful they become. Even in camping trips a patrol roughs it and lives as cheaply as at home. In scouting all boys have the same advantages. Each has the chance of a healthy, moral, mental and physical development, and each has his character built and moulded by the principles and daily habits of life which arise from his activities in scouting.

References: The Official Handbook for Boys, published by the Editorial Board of the National Council; Two Little Savages, by Ernest Thompson-Seton; The Boy Problem, by W. B. Forbush; First Aid to the Injured, edited by the International Committee of the Y. M. C. A.; Camping and Woodcraft, by Horace Kephart; Emergencies, by C. V. Gulick; The Boy Pioneers, by Dan C. Beard; The Handbook for Scout Masters, published by the Editorial Board of the Boy Scouts of America; The Coming Generation, by W. B. Forbush; Boy Training, by John L. Alexander; Boy Life and Self-Government, by George W. Fiske. For full biography upon Scout work and the different phases of Scouting see the Appendix of the different publications and handbooks of the Boy Scouts of America.

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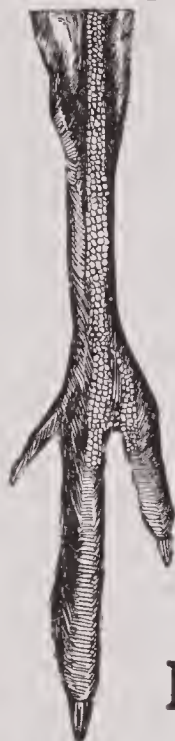
When is a person near-sighted?

What caused the Turco-Italian and Balkan Wars?

How and when did China become a Republic?

How did Edison invent the phonograph?

Name the three chief classes of Opera?



What is the difference between a rabbit and a hare?

What is the strength of our Army and Navy?

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